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42525

Final Report
UM-HSRI-79-6

June 28, 1979

VALIDATION COMMAND LANGUAGE

(1979 VERSION)

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Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
UM-HSRI-79-6		

4. Title and Subtitle	5. Report Date
Validation Command Language (1979 Version)	June 28, 1979
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
Bennett, R.O., Becker, J.M. and Robbins, D.H.	UM-HSRI-79-6
9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Highway Safety Research Institute University of Michigan Huron Pkwy. & Baxter Rd., Ann Arbor, MI 48109	361727 11. Contract or Grant No.
12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Motor Vehicle Manufacturers Association, Inc. 320 New Center Building Detroit, Michigan 48202	Final Report 7/1/78 through 6/29/79 14. Sponsoring Agency Code

15. Supplementary Notes This report is an update of the report UM-HSRI-76-20, released December 10, 1976, and titled "Validation Command Language." Users of Version 4 of the MVMA 2-D Crash Victim Simulation model must use this updated manual.

16. Abstract

This report describes the features and use of the Validation Command Language (VCL) computer program which has been developed to aid the automotive safety researcher in quantifying comparison between impact test results and predictions of mathematical simulations. Anticipated applications of this software are:

1. Manipulation, analysis and comparison of dynamic impact data,
2. Graphical presentation of dynamic impact data,
3. Simplification of procedures necessary for quantitative validation of mathematical models, and
4. Demonstration of correlation or the lack thereof between experiments and/or theoretical estimates.

Additional Formula Interpreter software carries the manipulation and analysis capability a bit further. If a new analytically based performance criterion is developed, the user can invest the formula as data and retrieve the results without further post-processing.

17. Key Words	18. Distribution Statement
	Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	106	

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1.0 INTRODUCTION

This report describes the features and use of the Validation Command Language (VCL) computer program which has been developed to aid the automotive safety researcher in quantifying comparisons between impact test results and predictions of mathematical simulations. Although these simulations have been installed on various computers, both within and outside the industry, extensive validations have been carried out only within the industry. The proprietary nature of the automotive hardware used in the test programs necessitates that the results be kept proprietary. This fact leads safety researchers and government standards writers not having access to the data to question the potential and applicability of models. The VCL will aid in publicizing models, many of which have been developed largely under MVMA funding, and demonstrating their accuracy.

1.1 Description of the Validation Command Language

Procedures have been developed by which the output from two-dimensional and three-dimensional mathematical model simulations of specific crashes can be quantitatively compared to the results of experimentally staged simulations of the same crash. Since crash victim simulation deals with the physical parameters of crash victim dynamics, it is desirable to compare output from the model with the same types of physical parameters gathered during experimental simulation. The comparison techniques accomodate variance between computed and experimentally measured variables which may differ in amplitude, phase, and frequency content. The procedure, which is general enough to be used in comparisons of any two or more sets of simulated and/or physical data, has been demonstrated utilizing the MVMA Two-Dimensional Crash Victim Simulation model in the text which follows.

The VCL has been structured to provide:

1. User ease;
2. Self-contained analytical power; and
3. Graphical output capability.

The technique of a command language has been chosen to provide user ease.

It consists of simple English words which can be entered into the computer at a remote terminal or in a batch process. The words are designed for use by a wide range of professionals whether they be an engineer or computer programmer -- a designer or a manager. With these commands, the user can operate with the three basic elements of a validation procedure:

1. Experimental and/or mathematically simulated data files;

2. Analytical tools with the capability of comparing data files, computing statistical parameters and injury indices, combining variables, etc.; and,

3. Output graphic displays showing validation, correlation and/or comparisons.

Commands in VCL are described in Part 2.2 of the report. Examples of their use are given in Part 2.4.

One of the primary features of VCL is that provision has been made for a large collection of analytical tools which can be used to operate on the subject data sets:

1. Simple file manipulation,

2. Determination of Fourier coefficients of a digitized time dependent signal;

3. Signal integration (HIC, severity index, area, etc.);

4. Statistical measures (minimum, maximum, variance, median, confidence interval length, etc.);

5. Data filtering with filter definition chosen by the user;

6. Regression fitting of data; and,

7. Implementation of user supplied formula combining physical data quantities in a simple analytical expression (Formula Interpreter).

The important fact to note is that the software associated with the various analytical procedures have been provided with the VCL thus making it a stand-alone package.

Additional power is provided by the Formula Interpreter. In those cases where a particular standard analytical tool is not available for operation on a data set, the user can write an analytical expression combining the pertinent data quantities and insert it as input data. The resulting formula will then be evaluated automatically. Therefore, the user can:

1. supply his own performance indicators;
2. compute resultant accelerations, etc.; and,
3. perform complex data file combinations.

After the user has operated on the subject data files using the interactive commands of VCL, he is provided with additional commands for the purpose of producing useful and demonstrative graphic output. Labels, units, and scales are at user option. The three types of standard plots available are:

1. Cartesian (x vs. y for up to five variables);
2. Phase plane; and,
3. Deviation (x-y vs. time for up to five plots).

In addition, a summary plot containing all the discrete comparison or validation indicators can be produced. This plot is in the form of a polar plot with the various quantities printed along the various radii. Example plots are shown in Part 2.4 of the report.

1.2 Applications of the Validation Command Language

In attempting to determine the "validity" of mathematical crash victim simulations and, for that matter, experimental simulations of crash events, the following question always seems to arise: "How does one compare the results of impact events?" It follows that the two problems which must be faced in establishing validity are: 1. the making of decisions on what performance indicators should be used and how good the comparisons should be on a quantitative basis; and, 2. the actual comparison of analytical and/or experimental data. A variety of performance indicators have been proposed for one application or another by industrial, governmental and other groups. Several of the more common of these are included among the computational tools of the VCL. However, there is no real consensus within the highway safety community as to an ultimate performance indicator or definition of validation.

The VCL has been developed to serve within the present scenario of safety and restraint system research and evaluation. In this regard, the anticipated applications are summarized in the following list:

1. Manipulation, analysis and comparison of dynamic impact data;

2. Graphical presentation of dynamic impact data;

3. Use as an organizing tool to simplify quantitative validation of mathematical models; and,

4. Use as an organizing tool to demonstrate correlation or the lack thereof between experiments and/or theoretical estimates.

The Formula Interpreter software carries the manipulation and analysis capability a bit further. If a new analytically-based performance criteria is developed, the user can insert the formula as data and retrieve the results without further post-processing.

In conclusion, the VCL has been developed to provide the user with software necessary for conducting validation or correlation studies given experimental or simulated data. It is not capable of making a decision for him as to whether a model is valid, but rather, is intended to provide him with the tools he needs to aid him in making the decision.

This manual applies only to the Validation Command Language for Version 4 of the MVMA 2-D CVS model. Users of VCL for Version 3 should refer to the December 10, 1976, HSRI report number UM-HSRI-76-20. Users of VCL for the CAL 3-D model should refer to that same report and additionally to Appendix C of the April 1978 Monthly Report to NHTSA on Contract DOT-HS-7-01659.

2.0 USER'S GUIDE FOR THE VALIDATION COMMAND LANGUAGE

2.1 Validation Command Language Specification

The purpose of the Validation Command Language is to provide aid in data reduction, data preparation, data presentation, comparison of model results and experimental results, and the presentation of such comparisons. These computational services are made available in the form of a command language in order to provide maximum flexibility. This Command Language is currently implemented only for use on runs for the MVMA Two-Dimensional CVS Model and experimental data. A second version of the command language has been developed for use on runs of the CAL 3-D program and experimental data.

The Command Language is broken into the following major divisions:

Division Name	Explanation
1. Identification	Specification of model runs, experimental data and general control information
2. Assessment	Checking the data for flaws and general properties
3. Preparation	Correcting the flaws found, computation of desired discrete quantities summarizing time-dependent quantities
4. Comparison	Various comparisons of discrete and time-dependent quantities
5. Presentation	Various options for presentation of quantities and comparisons.

Table 1 contains a detailed description of each command. The first column of this table shows a facsimile of the sentence which identifies the command together with markings which indicate possible abbreviations. The second column includes the shortest sentence abbreviations. The third column includes the necessary description for compiling the commands.

Underlined letters in the first column of each word are those upon which the identification of the card is made and must be correct. The identification process is confined to the first two words. These two words may be abbreviated by these two letters placed contiguously or separated by one or more blanks. The commands can be used in any order but all information for each command must be placed in the order shown and in one contiguous string of up to ten lines or cards.

Many commands require user-supplied names to identify data sets or constants in order to provide for later reference of the information generated by the command. Such names are indicated in Table 1 by a phrase in the command description beginning with a capital letter and containing the word "name." User-supplied names consist of any sequence of letters and numbers which is one to six characters long and begins with a letter. Such names are defined upon their first use and may be reused as many times as necessary. In case of subsequent use to hold the output of a command, the original values will be stored over.

The term "data set" always implies a set of values for a time-dependent variable specified at least at two time points. The term "constant" is used whenever the variable is time-independent or when only one time point is specified.

Where brackets enclose a number of choices separated by slashes in the command descriptions, one such choice must be made. Items enclosed in parentheses are optional. If an item is totally in capitals in the Command description, it is a code word and must appear as shown if it is used at all. Every command must end with a period.

Many commands contain a data section. The standard format for data sections is that all numerical values are specified as floating point numbers (in the Fortran F or E-format) and separated by commas with the end of data marked by an asterisk. Data must start on a new card from the card containing the period, must have at least one complete number specification per card, and the last number must be followed by an asterisk. Table 1 contains a description of the data to be included in the order in which it is to appear. Column three contains specification of any difference from the standard data format.

TABLE 1. VALIDATION COMMAND LANGUAGE FORMATS

Sentence Contents	Sentence Abbreviation	Notes
IDENTIFICATION DIVISION		
CONTROL PARAMETERS. (a) Print control = 0 no teletype output = 1 regular teletype output = 2 regular plus supplementary teletype output (b) Default final time (msec) (c) Output unit switch = 1 metric units = 2 English units	CP	If this command is completely left out, the three values default to 0, 300, and 1 respectively.
TEST RUN [Tapename/NONE]. (a) Logical device number to read tape or file.	TR	Tape name of digitized tape or NONE if information is in prepared file. Tape reading is not implemented in current program.
TEST QUANTITY Dataname (Filename). (a) Tape file number or file record number (≥ 1) (b) Time increment (msec) (c) Final time (msec)	TQ	Dataname is name by which this data is to be referenced. Filename is needed only for tape in TR and used as doublecheck. Tape file number is tape file which contains data. File record number is starting record of file which contains data. See Section 2.2.1 for details.
MODEL RUN. (a) Logical device number 1 (b) Logical device number 2	MR	Logical device numbers for the two MVMA catch files written on NU and MV respectively.
MODEL QUANTITY Dataname (Name A (Name B)). (a) MVMA output category number (b) MVMA output column number (c) Time increment (msec) (d) Final time (msec)	MQ	Identifying names Name A and Name B must be supplied to make certain data requests specific. See Section 2.2.2 for details.

TABLE 1. VALIDATION COMMAND LANGUAGE FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes
ASSESSMENT DIVISION QUANTITY MEASURES Dataname.	QM	For all times present in data, this command prints minimum, maximum, mean, variance, mode, median and confidence interval length.
QUANTITY PHASE Dataname A Dataname B. (a) Starting start time for curve A (msec) (b) Increment of start time for curve A (msec) (c) Final start time for curve A (msec) (d) Time increment between points correlated for curve A (msec) (e) Starting start time for curve B (msec) (f) Increment of start time for curve B (msec) (g) Final start time for curve B (msec) (h) Time increment between points correlated for curve B (msec) (i) Number of points used in correlation	QP	Compares two data sets and prints maximum correlation and starting times for phase shift recognition. See section 2.2.3 for details.
QUANTITY AMPLIFICATION Dataname A Dataname B. (a) Starting time for points correlated on curve A (msec) (b) Increment of time points correlated on curve A (msec) (c) Starting time for points correlated on curve B (msec) (d) Increment of time points correlated on curve B (msec) (e) Number of points used in correlation (f) Starting amplitude factor (g) Increment of amplitude factor (h) Final amplitude factor	QA	Compares subsets of two data sets and prints maximum correlation and amplitude factor for recognition of calibration problems. See Section 2.2.4 for details.

TABLE 1. VALIDATION COMMAND LANGUAGE FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes
FOURIER COEFFICIENTS Dataname. (a) Start time of period (msec) (b) Time increment between points to be included (msec) (c) Final time of period (msec) (d) Number of harmonics to be computed	FC	Prints least squares approximation to Fourier coefficients. Presented subset of data considered one period. The number of coefficients printed is twice the number of harmonics plus one. See Section 2.2.5 for details.
PREPARATION DIVISION SHIFT ZERO Dataname Newdataname. (a) Start time (msec) (b) Time increment (msec) (c) Final time step (msec)	SZ	If $0 \leq (a) < (c)$, picks a subset of a data set and stores as a new data set. If (a) = (c), picks a single point and stores as a new constant. If (a) < 0, $\|(a)\| < (c)$, picks a subset, shifts time to start at zero, and stores as a new dataset.
FILTER GENERATION Filtername.	FG	Invokes interactive filter design program. See Section 2.2.6 for details.
FILTER DATA Dataname Newdataname Filtername.	FD	Applies filter to data set to produce a new data set. Filter either one produced by FG command or one of predefined filters. See Section 2.2.7 for details.
COMPUTE MEASURES Dataname. (a) Start time (msec) (b) Final time (msec)	CM	Produces eight constants with names derived from original name. The eight constants correspond to the minimum, maximum, mean, variance, mode, median, confidence interval length, and number of points minus one. See Section 2.2.8 for details.
COMPUTE HIC Dataname Newdataname. (a) Number of points the T1 of a HIC duration is indexed (b) Number of points the T2 of a HIC duration is indexed (c) Fraction of max HIC below which scanning is stopped	CH	Produces a constant which is the HIC of data set supplied. See Section 2.2.9 for details.

TABLE 1. VALIDATION COMMAND LANGUAGE FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes
COMPUTE SEVERITY Dataname Newdataname. (a) Start time (msec) (b) Time increment (msec) (c) Final time step (msec)	CS	Produces a constant which is the original Severity Index of the data set supplied. See Section 2.2.9 for details.
COMPUTE GMRSI Dataname Newdataname. (a) Start time (msec) (b) Time increment (msec) (c) Final time(msec)	CG	Produces a constant which is the modified Severity Index of the data set supplied. See Section 2.2.9 for details.
THREE MILLISECOND Dataname. (a) Start time (msec) (b) Time increment (msec) (c) Final time (msec)	TM	Produces three constants which are peak value, three millisecond average, and the leading time of the three millisecond interval. See Section 2.2.9 for details.
COMPUTE INTEGRATION Dataname Newdataname. (a) Start time (b) Final time	CI	Produces a constant which is the Simpson's rule integral of the data over the specified interval.
COMPUTE FREQUENCY Dataname. (a) Start time of period (msec) (b) Interval of time for points used (msec) (c) Final time of period (msec) (d) Number of harmonics to be considered	CF	Produces two constants which are the maximum coefficient and the corresponding frequency for that coefficient. See Section 2.2.10 for details.
MODIFY AMPLITUDE Dataname Newdataname. (a) Factor (b) Start time (msec) (c) Time increment of points used (msec) (d) Final time (msec)	MA	Produces a new data set which has been multiplied point by point by the given factor.

TABLE 1. VALIDATION COMMAND LANGUAGE FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes
CORRELATE CURVES Dataname A Dataname B Newdataname. (a) Start time for data set A (msec) (b) Time increment for data set A (msec) (c) Final time for data set A (msec) (d) Start time for data set B (msec) (e) Time increment for data set B (msec)	CC	Produces a constant which is the correlation of data set A with data set B.
MINUS COMPUTATION Dataname A Dataname B Newdataname (a) Start time (msec) (b) Time increment (msec) (c) Final time (msec)	MC	Produces a new data set which is Dataname A minus Dataname B for the specified time points.
COMPARISON DIVISION		
COMPUTE VARIANCE Dataname A Dataname B.	CV	Computes and prints F-distribution comparison of variances. CM must have been previously run for each given data set.
POINTWISE MEANS Dataname 1 .... Dataname N Newdataname. (a) Start time for new data set (msec) (b) Time increment for new data set (msec) (c) Final time of the new data set (msec)	PM	Produces a new data set which is the mean of the given curves point by point together with four constants which are the minimum, maximum, mean and variance of the generated curve. See Section 2.2.11 for details.

TABLE 1. VALIDATION COMMAND LANGUAGE FORMATS (continued)

Sentence Contents	Sentence Abbreviation	Notes
REGRESSION FITTING Dataname A (Dataname B). (a) Start time of data to be fit (msec) (b) Time increment of data to be fit (msec) (c) Final time of data to be fit (msec) (d) Minimum degree of polynomial to be fitted (e) Maximum degree of polynomial to be fitted (f) Number of decimal places to print in printout (g) Switch = 1 if printout on batch ldn only = 2 if printout on both batch and interactive ldn's	RF	Computes and prints regression polynomials and fits specified. See Section 2.2.12 for details.
FORMULA INTERPRETER Newdataname. (a) Start time (msec) (b) Time increment (msec) (c) Final time (msec) [Formula of form: UU-dataname 1 0 ... OUU-dataname N$E on up to ten lines Note: $U stands for unary operator, 0 stands for binary operator.	FI	Fortran arithmetic statement combines variables, constants, and numeric values. Formula must start on a new line. Any dataname may be a dataset name, a constant name or a numeric quantity. See Section 2.2.13 for details.

TABLE 1. VALIDATION COMMAND LANGUAGE FORMATS (Continued)

Sentence Contents	Sentence Abbreviation	Notes
PRESENTATION DIVISION		
START PLOT [PRINT/OFF-LINE] [POLAR/PHASE/CART/DEV]. A. For POLAR only: (a) Fractional margin position (b) Fractional minimum acceptance circle displacement from unity (c) Fractional maximum acceptance circle displacement from unity B. For PHASE only: (a) Maximum Y coordinate for plot area (optional) (b) Minimum Y coordinate for plot area (optional) (c) Minimum X coordinate for plot area (optional) (d) Maximum X coordinate for plot area (If a through c omitted, square area centered about zero produced) C. For both CART and DEV: (a) Maximum time plot on area (b) Minimum Y coordinate on plot area (c) Maximum Y coordinate on plot area	SP	Set up a plot. See Section 2.2.14 for details.
PLOT QUANTITY Dataname A Dataname B. (a) Angle at which ratio is to be plotted (deg)	PQ	Plots the ratio of constant A to constant B on a POLAR plot. May not be used for other plot types.
PLOT CURVE Dataname A (Dataname B).	PC	For CART: Plots Data set A as one of up to 5 curves. For PHASE: Plots Data set A as Y versus Data set B as X. Only one curve per plot. For DEV: Plots Data set A minus Data set B as Y and time as X. May have up to 5 curves.

TABLE 1. VALIDATION COMMAND LANGUAGE FORMATS (Continued)

Sentence Contents	Sentence Abbreviations	Notes
PLOT PLOT.	PP	Plots the existing plot images.
PRINT SINGLE Dataname.	PS	Prints the value of a constant.
TIME PRINT Dataname. (a) Start time (msec) (b) Time increment (msec) (c) Final time (msec)	TP	Prints the values of a data set.

2.2 Description of Command Language Quantities

This section of the report includes text material to supplement Table 1 of Section 2.1. The intent is to provide the user with information so that he can use the Command Language with the aid of only Table 1 and this section.

2.2.1 Test Data Specifications (TR and TQ)

Experimental data may be supplied to the Validation Command Language in the form of tape and in the form of a fixed format file. Tape reading is provided for by a user-supplied tape reading subroutine (see Section 3.3.2 for details).

The fixed format file reading subroutine is supplied as part of the Command Language. This subprogram expects n + 2 records of input where n is the number of time points supplied. The first record contains five control parameters. The format of the first record is as follows:

(a) Start time (in msec) in columns one through five with decimal,

(b) Time increment (in msec) in columns six through ten with decimal,

(c) Number of time points right adjusted in columns eleven through thirteen,

(d) The dimension code index (see Table 2) right adjusted in columns fourteen through sixteen,

and (e) a switch (which is one for metric system and two for English system) right adjusted in columns seventeen through nineteen.

The second record contains the Fortran format of the remaining records enclosed in parentheses, anywhere in columns one through eighty. The word "FORMAT" must not appear in the specified format.

The remaining records contain the ordinate for each of the times implied by the three control parameters in the first record. Multiple TR's and TQ's may be used in one run of the Command Language, but all TQ's with reference to one TR must appear before the next TR. The tape or file of input data must be attached to the specified logical device number. The coordinate system is assumed positive upwards for positions and related quantities.

TABLE 2. TEST DATA QUANTITY DIMENSION CODE INDICES

Quantity Type	Dimensions	Code Index
distance	cm or in	1
vehicle velocity	kph or mph	2
velocity	m/s or f/s	3
force	N or lb	4
energy	J or ft-lb	5
velocity	cm/s or in/s	6
torque or moment	N-m or lb-in	7
pressure	N/sq cm or psi	8
temperature	°K or °R	9
volume	cm^3 or in^3	10
mass	kg or lbm	11
mass flow	kg/s or lbm/s	12
acceleration	g's	-1
angles	deg	-2
angular velocity	deg/sec	-3
angular acceleration	rad/sec^2	-4

2.2.2 Model Data Specifications (MR and MQ)

Model run data from a run of the MVMA Two-Dimensional CVS Model may be supplied to the Command Language using MR and MQ. The model data is specified by using the MVMA output category number, the MVMA output column number, and optional identifying names. Table 3 is used to determine these two numbers. Table 3 contains a descriptive alphabetical list of all the model quantities which may be recorded by the MVMA 2-D in the catch files attached to logical device numbers NU and MV. Listed with each descriptive title is the identifying category and column number.

If the category number is two, three, or four, the identifying names must be supplied in order to make the model quantity specification unique. The names are specified in fixed format as follows. The dataname supplied is followed by one blank, then a sixteen character Name A, then a blank, then a sixteen character Name B, and then a period. If the category number is two or three, Name A must be the name of a region specified in the run in question and Name B must be blank. If the category number is four, three cases exist. When the column number is in the range one to ten, Name A must be an ellipse name and Name B must be a line name. When the column number is in the range eleven to twenty one, Name A and Name B must both be ellipse names. When the column number is in the range twenty two to twenty-nine, Name A must be a belt name as shown in Table 4 and Name B must be blank.

Multiple MR's and MQ's may be used in one run of the Command Language, but all MQ's with reference to one MR must appear before the next MR. The catch files written while attached to the logical device numbers NU and MV during the model run must be attached to the two specified logical device numbers supplied respectively.

TABLE 3. MVMA 2-D Data Quantities Available (Page 1 of 9)

QUANTITY DESCRIPTION	CATG. NO.	COL. NO.
Airbag CG force components - head moment	20	3
Airbag CG force components - head x	20	1
Airbag CG force components - head z	20	2
Airbag CG force components - lower torso moment	20	12
Airbag CG force components - lower torso x	20	10
Airbag CG force components - lower torso z	20	11
Airbag CG force components - middle torso moment	20	9
Airbag CG force components - middle torso x	20	7
Airbag CG force components - middle torso z	20	8
Airbag CG force components - upper leg moment	20	15
Airbag CG force components - upper leg x	20	13
Airbag CG force components - upper leg z	20	14
Airbag CG force components - upper torso moment	20	6
Airbag CG force components - upper torso x	20	4
Airbag CG force components - upper torso z	20	5
Airbag contact forces - head pressure	19	1
Airbag contact forces - head tension	19	2
Airbag contact forces - lower torso pressure	19	7
Airbag contact forces - lower torso tension	19	8
Airbag contact forces - middle torso pressure	19	5
Airbag contact forces - middle torso tension	19	6
Airbag contact forces - upper leg pressure	19	9
Airbag contact forces - upper leg tension	19	10
Airbag contact forces - upper torso pressure	19	3
Airbag contact forces - upper torso tension	19	4
Airbag variables - bag gas mass	18	4
Airbag variables - bag pressure	18	1
Airbag variables - bag temperature	18	2
Airbag variables - bag volume	18	3
Airbag variables - mass flow in	18	5
Airbag variables - mass flow out	18	6
Airbag variables - supply temperature	18	7
Belt angles - lap belt inboard	5	1
Belt angles - lap belt outboard	5	2
Belt angles - torso belt lower	5	4
Belt angles - torso belt upper	5	3
Body joint coordinate - elbow x	13	9
Body joint coordinate - elbow z	13	10
Body joint coordinate - hip x	13	5
Body joint coordinate - hip z	13	6
Body joint coordinate - knee x	13	7
Body joint coordinate - knee z	13	8
Body joint coordinate - lower spine x	13	3
Body joint coordinate - lower spine z	13	4
Body joint coordinate - upper spine x	13	1
Body joint coordinate - upper spine z	13	2
Body joint velocity - elbow x	14	9
Body joint velocity - elbow z	14	10
Body joint velocity - hip x	14	5
Body joint velocity - hip z	14	6

TABLE 3. MVMA 2-D Data Quantities Available (Page 2 of 9)

QUANTITY DESCRIPTION	CATG. NO.	COL. NO.
Body joint velocity - knee x	14	7
Body joint velocity - knee z	14	8
Body joint velocity - lower spine x	14	3
Body joint velocity - lower spine z	14	4
Body joint velocity - upper spine x	14	1
Body joint velocity - upper spine z	14	2
Body link angles - head	10	1
Body link angles - lower arm	10	10
Body link angles - lower leg	10	7
Body link angles - lower torso	10	5
Body link angles - middle torso	10	4
Body link angles - neck	10	2
Body link angles - shoulder	10	8
Body link angles - upper arm	10	9
Body link angles - upper leg	10	6
Body link angles - upper torso	10	3
Body link angular acceleration - head	12	1
Body link angular acceleration - lower arm	12	10
Body link angular acceleration - lower leg	12	7
Body link angular acceleration - lower torso	12	5
Body link angular acceleration - middle torso	12	4
Body link angular acceleration - neck	12	2
Body link angular acceleration - shoulder	12	8
Body link angular acceleration - upper arm	12	9
Body link angular acceleration - upper leg	12	6
Body link angular acceleration - upper torso	12	3
Body link angular velocity - head	11	1
Body link angular velocity - lower arm	11	10
Body link angular velocity - lower leg	11	7
Body link angular velocity - lower torso	11	5
Body link angular velocity - middle torso	11	4
Body link angular velocity - neck	11	2
Body link angular velocity - shoulder	11	8
Body link angular velocity - upper arm	11	9
Body link angular velocity - upper leg	11	6
Body link angular velocity - upper torso	11	3
Center of mass resultant moment - head	32	1
Center of mass resultant moment - head applied force component	32	9
Center of mass resultant moment - lower arm	32	8
Center of mass resultant moment - lower leg	32	6
Center of mass resultant moment - lower torso	32	4
Center of mass resultant moment - middle torso	32	3
Center of mass resultant moment - upper arm	32	7
Center of mass resultant moment - upper leg	32	5
Center of mass resultant moment - upper torso	32	2
Center of mass x force component - head	30	1
Center of mass x force component - head applied force component	30	9
Center of mass x force component - lower arm	30	8
Center of mass x force component - lower leg	30	6

TABLE 3. MVMA 2-D Data Quantities Available (Page 3 of 9)

QUANTITY DESCRIPTION	CATG. NO	COL. NO.
Center of mass x force component - lower torso	30	4
Center of mass x force component - middle torso	30	3
Center of mass x force component - upper arm	30	7
Center of mass x force component - upper leg	30	5
Center of mass x force component - upper torso	30	2
Center of mass z force component - head	31	1
Center of mass z force component - head applied force component	31	9
Center of mass z force component - lower arm	31	8
Center of mass z force component - lower leg	31	6
Center of mass z force component - lower torso	31	4
Center of mass z force component - middle torso	31	3
Center of mass z force component - upper arm	31	7
Center of mass z force component - upper leg	31	5
Center of mass z force component - upper torso	31	2
Contact belt vs attachment - absorbed energy	4	29
Contact belt vs attachment - deflection rate	4	23
Contact belt vs attachment - deflection	4	22
Contact belt vs attachment - unadjusted tension	4	25
Contact belt vs attachment - resultant force	4	27
Contact belt vs attachment - resultant heading angle	4	28
Contact belt vs attachment - ring equilibrium tension	4	24
Contact belt vs attachment - tension adjustment	4	26
Contact ellipse vs ellipse - body segment x for ellipse A	4	18
Contact ellipse vs ellipse - body segment z for ellipse A	4	19
Contact ellipse vs ellipse - body segment x for ellipse B	4	20
Contact ellipse vs ellipse - body segment z for ellipse B	4	21
Contact ellipse vs ellipse - center point x for ellipse A	4	14
Contact ellipse vs ellipse - center point z for ellipse A	4	15
Contact ellipse vs ellipse - center point x for ellipse B	4	16
Contact ellipse vs ellipse - center point z for ellipse B	4	17
Contact ellipse vs ellipse - deflection rate	4	12
Contact ellipse vs ellipse - deflection	4	11
Contact ellipse vs ellipse - normal force	4	13
Contact ellipse vs line - contact point x on body segment	4	9
Contact ellipse vs line - contact point z on body segment	4	10
Contact ellipse vs line - contact point position on line	4	5
Contact ellipse vs line - contact point velocity on line	4	6

TABLE 3. MVMA 2-D Data Quantities Available (Page 4 of 9)

QUANTITY DESCRIPTION	CATG. NO.	COL. NO.
Contact ellipse vs line - contact point x in inertial space	4	7
Contact ellipse vs line - contact point z in inertial space	4	8
Contact ellipse vs line - deflection	4	1
Contact ellipse vs line - deflection rate	4	2
Contact ellipse vs line - normal force	4	3
Contact ellipse vs line - tangential force	4	4
Femur and tibia loads - femur axial at knee	40	2
Femur and tibia loads - femur axial at sensor	40	1
Femur and tibia loads - femur shear at knee	40	3
Femur and tibia loads - tibia axial at foot	40	5
Femur and tibia loads - tibia axial at knee	40	4
Filtered accelerations - chest A-P	7	4
Filtered accelerations - chest resultant	7	6
Filtered accelerations - chest S-I	7	5
Filtered accelerations - head A-P	7	1
Filtered accelerations - head resultant	7	3
Filtered accelerations - head S-I	7	2
Filtered accelerations - hip resultant	7	9
Filtered accelerations - hip x	7	7
Filtered accelerations - hip z	7	8
Filtered severity index - chest SI A-P	9	7
Filtered severity index - chest SI resultant	9	9
Filtered severity index - chest SI S-I	9	8
Filtered severity index - chest mod SI A-P	9	10
Filtered severity index - chest mod SI resultant	9	12
Filtered severity index - chest mod SI S-I	9	11
Filtered severity index - head SI A-P	9	1
Filtered severity index - head SI resultant	9	3
Filtered severity index - head SI S-I	9	2
Filtered severity index - head mod SI A-P	9	4
Filtered severity index - head mod SI resultant	9	6
Filtered severity index - head mod SI S-I	9	5
Friction component joint torque - elbow	25	8
Friction component joint torque - hip	25	5
Friction component joint torque - knee	25	6
Friction component joint torque - lower neck	25	2
Friction component joint torque - lower spine	25	4
Friction component joint torque - shoulder at arm	25	7
Friction component joint torque - upper neck	25	1
Friction component joint torque - upper spine	25	3
Joint absorbed energy - elbow	16	11
Joint absorbed energy - hip	16	6
Joint absorbed energy - knee	16	7
Joint absorbed energy - lower neck	16	2
Joint absorbed energy - lower spine	16	5
Joint absorbed energy - neck length	16	3
Joint absorbed energy - shoulder at arm	16	9

TABLE 3. MVMA 2-D Data Quantities Available (Page 5 of 9)

QUANTITY DESCRIPTION	CATG. NO.	COL. NO.
Joint absorbed energy - shoulder at torso	16	8
Joint absorbed energy - shoulder length	16	10
Joint absorbed energy - upper neck	16	1
Joint absorbed energy - upper spine	16	4
Joint friction absorbed energy - elbow	28	8
Joint friction absorbed energy - hip	28	5
Joint friction absorbed energy - knee	28	6
Joint friction absorbed energy - lower neck	28	2
Joint friction absorbed energy - lower spine	28	4
Joint friction absorbed energy - shoulder at arm	28	7
Joint friction absorbed energy - upper neck	28	1
Joint friction absorbed energy - upper spine	28	3
Joint muscle tension absorbed energy - elbow	39	8
Joint muscle tension absorbed energy - hip	39	6
Joint muscle tension absorbed energy - knee	39	7
Joint muscle tension absorbed energy - lower neck	39	2
Joint muscle tension absorbed energy - lower spine	39	5
Joint muscle tension absorbed energy - neck length	39	3
Joint muscle tension absorbed energy - shoulder at arm	39	11
Joint muscle tension absorbed energy - shoulder at torso	39	9
Joint muscle tension absorbed energy - shoulder length	39	10
Joint muscle tension absorbed energy - upper neck	39	1
Joint muscle tension absorbed energy - upper spine	39	4
Joint stop absorbed energy - elbow	27	9
Joint stop absorbed energy - hip	27	5
Joint stop absorbed energy - knee	27	6
Joint stop absorbed energy - lower neck	27	2
Joint stop absorbed energy - lower spine	27	4
Joint stop absorbed energy - shoulder at arm	27	7
Joint stop absorbed energy - shoulder length	27	8
Joint stop absorbed energy - upper neck	27	1
Joint stop absorbed energy - upper spine	27	3
Joint torques - elbow	15	9
Joint torques - hip	15	5
Joint torques - knee	15	6
Joint torques - lower neck	15	2
Joint torques - lower spine	15	4
Joint torques - shoulder at arm	15	8
Joint torques - shoulder at torso	15	7
Joint torques - upper neck	15	1
Joint torques - upper spine	15	3
Joint viscous absorbed energy - elbow	29	10
Joint viscous absorbed energy - hip	29	6
Joint viscous absorbed energy - knee	29	7
Joint viscous absorbed energy - lower neck	29	2
Joint viscous absorbed energy - lower spine	29	5
Joint viscous absorbed energy - neck length	29	3
Joint viscous absorbed energy - shoulder at arm	29	8
Joint viscous absorbed energy - shoulder length	29	9
Joint viscous absorbed energy - upper neck	29	1

TABLE 3. MVMA 2-D Data Quantities Available (Page 6 of 9)

QUANTITY DESCRIPTION	CATG NO.	COL. NO.
Joint viscous absorbed energy - upper spine	29	4
Kinetic energy - arms	17	5
Kinetic energy - head	17	2
Kinetic energy - head superior-inferior	17	4
Kinetic energy - torso	17	3
Kinetic energy - total body	17	1
Line movement of Point A x	3	1
Line movement of Point A z	3	2
Line movement of Point 1 x	3	3
Line movement of Point 1 z	3	4
Line movement of Point 2 x	3	5
Line movement of Point 2 z	3	6
Line movement of Point 3 x	3	7
Line movement of Point 3 z	3	8
Line movement of Point 4 x	3	9
Line movement of Point 4 z	3	10
Line movement of Point 5 x	3	11
Line movement of Point 5 z	3	12
Linear component of joint torque - elbow	23	8
Linear component of joint torque - hip	23	5
Linear component of joint torque - knee	23	6
Linear component of joint torque - lower neck	23	2
Linear component of joint torque - lower spine	23	4
Linear component of joint torque - shoulder at arm	23	7
Linear component of joint torque - upper neck	23	1
Linear component of joint torque - upper spine	23	3
Muscle tension forces - neck	38	10
Muscle tension forces - shoulder length	38	11
Muscle tension torque - elbow	38	9
Muscle tension torque - hip	38	5
Muscle tension torque - knee	38	6
Muscle tension torque - lower neck	38	2
Muscle tension torque - lower spine	38	4
Muscle tension torque - shoulder at arm	38	8
Muscle tension torque - shoulder at torso	38	7
Muscle tension torque - upper neck	38	1
Muscle tension torque - upper spine	38	3
Neck and shoulder forces - neck linear	37	1
Neck and shoulder forces - neck muscle	37	4
Neck and shoulder forces - neck non-linear	37	2
Neck and shoulder forces - neck total	37	5
Neck and shoulder forces - neck viscous	37	3
Neck and shoulder forces - shoulder linear	37	6
Neck and shoulder forces - shoulder muscle	37	9
Neck and shoulder forces - shoulder non-linear	37	7
Neck and shoulder forces - shoulder total	37	10
Neck and shoulder forces - shoulder viscous	37	8
Neck joint coordinates - lower neck x	21	5
Neck joint coordinates - lower neck z	21	6

TABLE 3. MVMA 2-D Data Quantities Available (Page 7 of 9)

QUANTITY DESCRIPTION	CATG. NO.	COL. NO.
Neck joint coordinates - lower neck x velocity	21	7
Neck joint coordinates - lower neck z velocity	21	8
Neck joint coordinates - neck length	21	9
Neck joint coordinates - neck length rate	21	10
Neck joint coordinates - upper neck x	21	1
Neck joint coordinates - upper neck z	21	2
Neck joint coordinates - upper neck x velocity	21	3
Neck joint coordinates - upper neck z velocity	21	4
Nonlinear component of joint torque - elbow	24	8
Nonlinear component of joint torque - hip	24	5
Nonlinear component of joint torque - knee	24	6
Nonlinear component of joint torque - lower neck	24	2
Nonlinear component of joint torque - lower spine	24	4
Nonlinear component of joint torque - shoulder at arm	24	7
Nonlinear component of joint torque - upper neck	24	1
Nonlinear component of joint torque - upper spine	24	3
Quantity for region - average migration XR	2	3
Quantity for region - average migration ZR	2	4
Quantity for region - end point movement A-X	2	5
Quantity for region - end point movement A-Z	2	6
Quantity for region - end point movement B-X	2	7
Quantity for region - end point movement B-Z	2	8
Quantity for region - force component XR	2	1
Quantity for region - force component ZR	2	2
Quantity for region - number ellipse contacting	2	9
Shoulder joint coordinates - shoulder at arm x	22	5
Shoulder joint coordinates - shoulder at arm z	22	6
Shoulder joint coordinates - shoulder at arm x velocity	22	7
Shoulder joint coordinates - shoulder at arm z velocity	22	8
Shoulder joint coordinates - shoulder at torso x	22	1
Shoulder joint coordinates - shoulder at torso z	22	2
Shoulder joint coordinates - shoulder at torso x velocity	22	3
Shoulder joint coordinates - shoulder at torso z velocity	22	4
Shoulder joint coordinates - shoulder length	22	9
Shoulder joint coordinates - shoulder length rate	22	10
Steering column coordinates - gear box x	33	11
Steering column coordinates - gear box z	33	12
Steering column coordinates - wheel attachment point x	33	9
Steering column coordinates - wheel attachment point x	33	10
Steering column coordinates - wheel hub x	33	7
Steering column coordinates - wheel hub z	33	8
Steering column coordinates - wheel lower edge x	33	1
Steering column coordinates - wheel lower edge z	33	2

TABLE 3. MVMA 2-D Data Quantities Available (Page 8 of 9)

QUANTITY DESCRIPTION	CATG. NO.	COL. NO.
Steering column coordinates - wheel middle edge x	33	3
Steering column coordinates - wheel middle edge z	33	4
Steering column coordinates - wheel upper edge x	33	5
Steering column coordinates - wheel upper edge z	33	6
Steering column force components - head moment	36	3
Steering column force components - head x	36	1
Steering column force components - head z	36	2
Steering column force components - lower torso moment	36	12
Steering column force components - lower torso x	36	10
Steering column force components - lower torso z	36	11
Steering column force components - middle torso moment	36	9
Steering column force components - middle torso x	36	7
Steering column force components - middle torso z	36	8
Steering column force components - upper torso moment	36	6
Steering column force components - upper torso x	36	4
Steering column force components - upper torso z	36	5
Steering column forces - lower column extensional normal force	35	10
Steering column forces - lower hinge moment	35	12
Steering column forces - upper column extensional normal force	35	9
Steering column forces - upper hinge moment	35	11
Steering column forces - wheel hub normal force	35	7
Steering column forces - wheel hub tangential force	35	8
Steering column forces - wheel lower edge normal force	35	1
Steering column forces - wheel lower edge tangential force	35	2
Steering column forces - wheel middle edge normal force	35	3
Steering column forces - wheel middle edge tangential force	35	4
Steering column forces - wheel upper edge normal force	35	5
Steering column forces - wheel upper edge tangential force	35	6
Steering column kinematics - lower column extensional displacement	34	3
Steering column kinematics - lower column extensional velocity	34	4
Steering column kinematics - lower hinge angular displacement	34	7
Steering column kinematics - lower hinge angular velocity	34	8
Steering column kinematics - upper column extensional displacement	34	1
Steering column kinematics - upper column extensional velocity	34	2

TABLE 3. MVMA 2-D Data Quantities Available (Page 9 of 9)

QUANTITY DESCRIPTION	CATG. NO.	COL. NO.
Steering column kinematics - upper hinge angular displacement	34	5
Steering column kinematics - upper hinge angular velocity	34	6
Unfiltered accelerations - chest A-P	6	4
Unfiltered accelerations - chest resultant	6	6
Unfiltered accelerations - chest S-I	6	5
Unfiltered accelerations - head A-P	6	1
Unfiltered accelerations - head resultant	6	3
Unfiltered accelerations - head S-I	6	2
Unfiltered accelerations - hip resultant	6	9
Unfiltered accelerations - hip x	6	7
Unfiltered accelerations - hip z	6	8
Unfiltered severity index - chest SI A-P	8	7
Unfiltered severity index - chest SI resultant	8	9
Unfiltered severity index - chest SI S-I	8	8
Unfiltered severity index - chest modified SI A-P	8	10
Unfiltered severity index - chest modified SI resultant	8	12
Unfiltered severity index - chest modified SI S-I	8	11
Unfiltered severity index - head SI A-P	8	1
Unfiltered severity index - head SI resultant	8	3
Unfiltered severity index - head SI S-I	8	2
Unfiltered severity index - head modified SI A-P	8	4
Unfiltered severity index - head modified SI resultant	8	6
Unfiltered severity index - head modified SI S-I	8	5
Vehicle response - horizontal acceleration	1	4
Vehicle response - horizontal displacement	1	2
Vehicle response - horizontal time	1	1
Vehicle response - horizontal velocity	1	3
Vehicle response - pitch acceleration	1	10
Vehicle response - pitch angle	1	8
Vehicle response - pitch velocity	1	9
Vehicle response - vertical acceleration	1	7
Vehicle response - vertical displacement	1	5
Vehicle response - vertical velocity	1	6
Viscosity component joint torque - elbow	26	8
Viscosity component joint torque - hip	26	5
Viscosity component joint torque - knee	26	6
Viscosity component joint torque - lower neck	26	2
Viscosity component joint torque - lower spine	26	4
Viscosity component joint torque - shoulder at arm	26	7
Viscosity component joint torque - upper neck	26	1
Viscosity component joint torque - upper spine	26	3

TABLE 4 BELT IDENTIFIER NAMES

Belt Name	Report Belt Number	Internal Belt Number
A. Advanced Belts		
OUTBOARDbLAPbBLT	3	15
INBOARDbLAPbBELT	4	9
UPPERbTORSObBELT	1	11
LOWERbTORSObBELT	2	13
LOWERbRINGbSTRAP	5	17
UPPERbRINGbSTRAP	6	19
TORSObBELTbEXT.b	7	21
B. Old Belts		
bbbbLAPbBELTbbbb	1	9
UPPERbTORSObBELT	2	11
LOWERbTORSObBELT	3	13

NOTE: Each small letter "b" signifies a blank column. The name must be specified exactly as shown to be recognized.

2.2.3 Data Phase Recognition (QP)

The Quantity Phase Command is provided to aid the user in recognizing a phase shift between two data sets. The technique employed is to make repeated correlations sliding the interval for correlation along the two data sets. If the maximum correlation is near one, the data should be further examined for phase shift.

The user indicates the starting times to be used on the two curves by specifying a start starting time, an increment, and final starting time for each curve. All combinations of starting times are correlated and the maximum correlation selected.

2.2.4 Calibration Recognition (QA)

The Quantity Amplitude command uses a technique completely equivalent to that discussed in Section 2.2.3 to aid in recognition of a calibration problem. In this case, the repeated correlations are over fixed set of points on the time and the multiplying factor is varied. Again, if the maximum correlation is near one, the data should be examined further for calibration problems.

2.2.5 Fourier Analysis of Data (FC)

The Fourier Coefficients command is provided to aid in analyzing the frequency composition of an interval of data. The current version uses a least squares algorithm to approximate the Fourier coefficients. This technique assumes that the subset of time points is exactly one period and computes harmonics based on that. The user will find it necessary to apply this command repeatedly over relatively small intervals to gain an approximation to the frequency half of one less than the number of data points.

2.2.6 Generation of Digital Filters (FG)

The Validation Command Language incorporates an interactive filter design program from other sources (see Section 3.3.4 for details). This program is largely self-explanatory as far as input data is concerned. Control information is expected as an integer five wide except the response to "Enter the number of the band with weight = 1" which is to be an integer two wide. Integers must be right adjusted. Frequency information is expected with a decimal point. The response to "Freq. of upper edge, ripple (gain)" or "Lower edge, ripple (gain)" are expected as floating point fifteen wide. The response to "Beg, End, Points?" is expected as floating point ten wide.

The basic technique is to describe the filter by describing its frequency response in terms of up to ten bands with stated frequency beginnings, frequency endings, and gains given in decibels. The frequency interval between the ending of one band and the beginning of the next one is where the transition from one constant level takes place.

In the case of a low pass filter, the relationship between the pass-band ripple, the stopband gain, the filter length, and the transition width has been investigated and the empirical results of that investigation have been developed into a set of filter design tables. Four of these tables have been included as Table 5 of this report. The tables are used as follows, given a passband ripple and a stopband gain determine the minimum transition width and/or the minimum size filter from the appropriate column of the table. The transition widths are normalized and may be applied to a given sampling rate by multiplying the transition width times the sampling rate and dividing by a thousand to obtain the transition width for that sampling rate.

2.2.7 Filtering of Data (FD)

Filtering of data is achieved by a technique of filtering twice, once forward and once backward. This is done to leave the filtered data unbiased. The Table 5 compensates for this two step filtering in its combined ripples and gains.

Filtering can be carried out by use of filters created by the command FG or by use of one of twenty predefined filters. The predefined filters are listed in Table 6. The normalized frequencies are applied to a specific case by multiplying by the sampling rate. The last two predefincd filters are used to escape adding alias to data that is going to be taken every other point or every fourth point in forming a new data set. Note that the predefined filters can be used only with data sets of at least 150 points.

TABLE 5. FILTER DESIGN TABLES (1 of 4)

TABLE: T= 1

APPROXIMATE LOW-PASS FILTER DESIGN TABLES

PASSBAND 2*RIPPLE: 0.0100 DB
STOPBAND 2*GAIN: -40 TO -120 DB

FLTER LENTH N		TRANSITION WIDTH: 1000*(FS-FP) -40	-50	-60	-70	-80	-90	-100	-120		FLTER LENTH N
9	--	210.	223.	235.	248.	259.	271.	282.	303.	--	9
11	--	180.	192.	203.	214.	225.	235.	246.	265.	--	11
13	--	157.	167.	177.	187.	197.	207.	216.	235.	--	13
15	--	138.	148.	157.	166.	175.	184.	193.	210.	--	15
17	--	123.	132.	140.	149.	157.	165.	173.	189.	--	17
19	--	111.	119.	127.	135.	142.	150.	157.	172.	--	19
21	--	101.	108.	116.	123.	130.	137.	144.	158.	--	21
23	--	93.	99.	106.	113.	119.	126.	132.	145.	--	23
25	--	85.	92.	98.	104.	110.	116.	122.	134.	--	25
27	--	79.	85.	91.	97.	102.	108.	114.	125.	--	27
29	--	74.	79.	85.	90.	96.	101.	106.	117.	--	29
31	--	69.	74.	79.	84.	90.	95.	100.	110.	--	31
33	--	65.	70.	75.	79.	84.	89.	94.	103.	--	33
35	--	61.	66.	70.	75.	80.	84.	89.	98.	--	35
37	--	58.	62.	67.	71.	75.	80.	84.	92.	--	37
39	--	55.	59.	63.	67.	72.	76.	80.	88.	--	39
41	--	52.	56.	60.	64.	68.	72.	76.	84.	--	41
43	--	50.	54.	57.	61.	65.	69.	72.	80.	--	43
45	--	48.	51.	55.	58.	62.	66.	69.	76.	--	45
47	--	46.	49.	53.	56.	59.	63.	66.	73.	--	47
49	--	44.	47.	50.	54.	57.	60.	64.	70.	--	49
51	--	42.	45.	48.	52.	55.	58.	61.	67.	--	51
53	--	40.	44.	47.	50.	53.	56.	59.	65.	--	53
55	--	39.	42.	45.	48.	51.	54.	57.	63.	--	55
57	--	38.	40.	43.	46.	49.	52.	55.	60.	--	57
59	--	36.	39.	42.	45.	47.	50.	53.	58.	--	59
61	--	35.	38.	40.	43.	46.	48.	51.	56.	--	61
63	--	34.	37.	39.	42.	44.	47.	50.	55.	--	63
65	--	33.	35.	38.	40.	43.	45.	48.	53.	--	65
67	--	32.	34.	37.	39.	42.	44.	47.	51.	--	67
69	--	31.	33.	36.	38.	40.	43.	45.	50.	--	69
73	--	29.	32.	34.	36.	38.	40.	43.	47.	--	73
77	--	28.	30.	32.	34.	36.	38.	41.	45.	--	77
81	--	26.	28.	30.	32.	34.	36.	39.	43.	--	81
85	--	25.	27.	29.	31.	33.	35.	37.	41.	--	85
89	--	24.	26.	28.	30.	31.	33.	35.	39.	--	89
93	--	23.	25.	27.	28.	30.	32.	34.	37.	--	93
97	--	22.	24.	25.	27.	29.	30.	32.	35.	--	97
101	--	21.	23.	24.	26.	28.	29.	31.	34.	--	101
105	--	20.	22.	23.	25.	27.	28.	30.	33.	--	105
109	--	20.	21.	23.	24.	26.	27.	29.	32.	--	109
113	--	19.	20.	22.	23.	25.	26.	28.	30.	--	113
117	--	18.	20.	21.	22.	24.	25.	27.	29.	--	117
121	--	18.	19.	20.	22.	23.	24.	26.	28.	--	121
125	--	17.	18.	20.	21.	22.	24.	25.	28.	--	125

TABLE: T- 5

APPROXIMATE LOW-PASS
FILTER DESIGN TABLES

PASSBAND 2*RIPPLE: 0.0500 DB
STOPBAND 2*GAIN: -40 TO -120 DB

FLTER LENTH N		TRANSITION WIDTH: 1000*(FS-FP) -40	-50	-60	-70	-80	-90	-100	-120		FLTER LENTH N
9	--	173.	186.	198.	210.	222.	234.	245.	267.	--	9
11	--	147.	158.	170.	181.	192.	202.	212.	232.	--	11
13	--	127.	137.	148.	158.	167.	177.	187.	205.	--	13
15	--	111.	121.	130.	139.	148.	157.	166.	183.	--	15
17	--	99.	108.	116.	124.	133.	141.	149.	164.	--	17
19	--	89.	97.	105.	112.	120.	127.	135.	149.	--	19
21	--	81.	88.	95.	102.	109.	116.	123.	136.	--	21
23	--	74.	81.	87.	94.	100.	106.	113.	125.	--	23
25	--	68.	74.	80.	86.	92.	98.	104.	116.	--	25
27	--	63.	69.	75.	80.	86.	91.	97.	108.	--	27
29	--	59.	64.	70.	75.	80.	85.	90.	101.	--	29
31	--	55.	60.	65.	70.	75.	80.	85.	94.	--	31
33	--	52.	57.	61.	66.	70.	75.	80.	89.	--	33
35	--	49.	53.	58.	62.	67.	71.	75.	84.	--	35
37	--	46.	50.	55.	59.	63.	67.	71.	79.	--	37
39	--	44.	48.	52.	56.	60.	64.	68.	75.	--	39
41	--	42.	46.	49.	53.	57.	61.	64.	72.	--	41
43	--	40.	43.	47.	51.	54.	58.	61.	69.	--	43
45	--	38.	41.	45.	48.	52.	55.	59.	66.	--	45
47	--	36.	40.	43.	46.	50.	53.	56.	63.	--	47
49	--	35.	38.	41.	44.	48.	51.	54.	60.	--	49
51	--	34.	37.	40.	43.	46.	49.	52.	58.	--	51
53	--	32.	35.	38.	41.	44.	47.	50.	56.	--	53
55	--	31.	34.	37.	40.	42.	45.	48.	54.	--	55
57	--	30.	33.	35.	38.	41.	44.	46.	52.	--	57
59	--	29.	32.	34.	37.	40.	42.	45.	50.	--	59
61	--	28.	31.	33.	36.	38.	41.	43.	48.	--	61
63	--	27.	30.	32.	35.	37.	39.	42.	47.	--	63
65	--	26.	29.	31.	33.	36.	38.	41.	45.	--	65
67	--	25.	28.	30.	32.	35.	37.	39.	44.	--	67
69	--	25.	27.	29.	32.	34.	36.	38.	43.	--	69
73	--	23.	25.	28.	30.	32.	34.	36.	40.	--	73
77	--	22.	24.	26.	28.	30.	32.	34.	38.	--	77
81	--	21.	23.	25.	27.	29.	31.	33.	36.	--	81
85	--	20.	22.	24.	26.	27.	29.	31.	35.	--	85
89	--	19.	21.	23.	24.	26.	28.	30.	33.	--	89
93	--	18.	20.	22.	23.	25.	27.	28.	32.	--	93
97	--	18.	19.	21.	22.	24.	26.	27.	30.	--	97
101	--	17.	18.	20.	21.	23.	25.	26.	29.	--	101
105	--	16.	18.	19.	21.	22.	24.	25.	28.	--	105
109	--	16.	17.	18.	20.	21.	23.	24.	27.	--	109
113	--	15.	16.	18.	19.	21.	22.	23.	26.	--	113
117	--	15.	16.	17.	19.	20.	21.	23.	25.	--	117
121	--	14.	15.	17.	18.	19.	21.	22.	24.	--	121
125	--	14.	15.	16.	17.	19.	20.	21.	24.	--	125

TABLE 5. FILTER DESIGN TABLES (3 of 4)

TABLE: T- 7

APPROXIMATE LOW-PASS
FILTER DESIGN TABLES

PASSBAND 2*RIPPLE: 0.1000 DB
STOPBAND 2*GAIN: -40 TO -120 DB

FLTER LENTH N	TRANSITION WIDTH: 1000*(FS-FP) -40	-50	-60	-70	-80	-90	-100	-120	FLTER LENTH N
9 --	156.	169.	181.	194.	206.	217.	229.	250.	-- 9
11 --	132.	143.	155.	166.	177.	187.	198.	218.	-- 11
13 --	114.	124.	134.	144.	154.	164.	173.	191.	-- 13
15 --	100.	109.	118.	127.	136.	145.	153.	170.	-- 15
17 --	89.	97.	105.	113.	122.	130.	137.	153.	-- 17
19 --	80.	87.	95.	102.	110.	117.	124.	139.	-- 19
21 --	72.	79.	86.	93.	100.	107.	113.	127.	-- 21
23 --	66.	72.	79.	85.	92.	98.	104.	116.	-- 23
25 --	61.	67.	73.	79.	85.	90.	96.	108.	-- 25
27 --	56.	62.	67.	73.	78.	84.	89.	100.	-- 27
29 --	52.	58.	63.	68.	73.	78.	83.	93.	-- 29
31 --	49.	54.	59.	64.	69.	73.	78.	88.	-- 31
33 --	46.	51.	55.	60.	64.	69.	73.	82.	-- 33
35 --	43.	48.	52.	56.	61.	65.	69.	78.	-- 35
37 --	41.	45.	49.	53.	58.	62.	66.	74.	-- 37
39 --	39.	43.	47.	51.	55.	58.	62.	70.	-- 39
41 --	37.	41.	45.	48.	52.	56.	59.	67.	-- 41
43 --	35.	39.	42.	46.	50.	53.	57.	64.	-- 43
45 --	34.	37.	41.	44.	47.	51.	54.	61.	-- 45
47 --	32.	36.	39.	42.	45.	49.	52.	58.	-- 47
49 --	31.	34.	37.	40.	43.	47.	50.	56.	-- 49
51 --	30.	33.	36.	39.	42.	45.	48.	54.	-- 51
53 --	29.	32.	34.	37.	40.	43.	46.	52.	-- 53
55 --	28.	30.	33.	36.	39.	41.	44.	50.	-- 55
57 --	27.	29.	32.	35.	37.	40.	43.	48.	-- 57
59 --	26.	28.	31.	33.	36.	39.	41.	46.	-- 59
61 --	25.	27.	30.	32.	35.	37.	40.	45.	-- 61
63 --	24.	26.	29.	31.	34.	36.	39.	43.	-- 63
65 --	23.	26.	28.	30.	33.	35.	37.	42.	-- 65
67 --	23.	25.	27.	29.	32.	34.	36.	41.	-- 67
69 --	22.	24.	26.	29.	31.	33.	35.	40.	-- 69
73 --	21.	23.	25.	27.	29.	31.	33.	37.	-- 73
77 --	20.	22.	24.	26.	28.	30.	32.	36.	-- 77
81 --	19.	21.	22.	24.	26.	28.	30.	34.	-- 81
85 --	18.	20.	21.	23.	25.	27.	29.	32.	-- 85
89 --	17.	19.	20.	22.	24.	26.	27.	31.	-- 89
93 --	16.	18.	20.	21.	23.	24.	26.	29.	-- 93
97 --	16.	17.	19.	20.	22.	23.	25.	28.	-- 97
101 --	15.	16.	18.	20.	21.	23.	24.	27.	-- 101
105 --	14.	16.	17.	19.	20.	22.	23.	26.	-- 105
109 --	14.	15.	17.	18.	19.	21.	22.	25.	-- 109
113 --	13.	15.	16.	17.	19.	20.	21.	24.	-- 113
117 --	13.	14.	16.	17.	18.	19.	21.	23.	-- 117
121 --	12.	14.	15.	16.	18.	19.	20.	23.	-- 121
125 --	12.	13.	15.	16.	17.	18.	19.	22.	-- 125

TABLE: T-13

APPROXIMATE LOW-PASS FILTER DESIGN TABLES

PASSBAND 2*RIPPLE: 0.5000 DB
STOPBAND 2*GAIN: -40 TO -120 DB

FLTER LENTH N		TRANSITION WIDTH: 1000*(FS-FP)									FLTER LENTH N
		-40	-50	-60	-70	-80	-90	-100	-120		
9	--	114.	127.	140.	153.	165.	176.	188.	210.	--	9
11	--	95.	107.	118.	129.	140.	151.	161.	181.	--	11
13	--	82.	92.	102.	112.	121.	131.	140.	158.	--	13
15	--	71.	80.	89.	98.	107.	115.	124.	140.	--	15
17	--	63.	71.	79.	87.	95.	103.	111.	126.	--	17
19	--	56.	64.	71.	78.	86.	93.	100.	114.	--	19
21	--	51.	58.	65.	71.	78.	84.	91.	103.	--	21
23	--	47.	53.	59.	65.	71.	77.	83.	95.	--	23
25	--	43.	49.	54.	60.	66.	71.	77.	88.	--	25
27	--	40.	45.	50.	56.	61.	66.	71.	81.	--	27
29	--	37.	42.	47.	52.	57.	62.	66.	76.	--	29
31	--	35.	39.	44.	48.	53.	58.	62.	71.	--	31
33	--	32.	37.	41.	46.	50.	54.	58.	67.	--	33
35	--	31.	35.	39.	43.	47.	51.	55.	63.	--	35
37	--	29.	33.	37.	41.	44.	48.	52.	60.	--	37
39	--	27.	31.	35.	39.	42.	46.	50.	57.	--	39
41	--	26.	30.	33.	37.	40.	44.	47.	54.	--	41
43	--	25.	28.	32.	35.	38.	42.	45.	52.	--	43
45	--	24.	27.	30.	33.	37.	40.	43.	49.	--	45
47	--	23.	26.	29.	32.	35.	38.	41.	47.	--	47
49	--	22.	25.	28.	31.	34.	36.	39.	45.	--	49
51	--	21.	24.	27.	29.	32.	35.	38.	43.	--	51
53	--	20.	23.	26.	28.	31.	34.	36.	42.	--	53
55	--	19.	22.	25.	27.	30.	32.	35.	40.	--	55
57	--	19.	21.	24.	26.	29.	31.	34.	39.	--	57
59	--	18.	21.	23.	25.	28.	30.	33.	38.	--	59
61	--	17.	20.	22.	25.	27.	29.	32.	36.	--	61
63	--	17.	19.	21.	24.	26.	28.	31.	35.	--	63
65	--	16.	19.	21.	23.	25.	27.	30.	34.	--	65
67	--	16.	18.	20.	22.	24.	27.	29.	33.	--	67
69	--	15.	18.	20.	22.	24.	26.	28.	32.	--	69
73	--	15.	17.	19.	20.	22.	24.	26.	30.	--	73
77	--	14.	16.	18.	19.	21.	23.	25.	29.	--	77
81	--	13.	15.	17.	18.	20.	22.	24.	27.	--	81
85	--	12.	14.	16.	18.	19.	21.	23.	26.	--	85
89	--	12.	14.	15.	17.	18.	20.	22.	25.	--	89
93	--	11.	13.	15.	16.	18.	19.	21.	24.	--	93
97	--	11.	12.	14.	15.	17.	18.	20.	23.	--	97
101	--	10.	12.	13.	15.	16.	18.	19.	22.	--	101
105	--	10.	11.	13.	14.	16.	17.	18.	21.	--	105
109	--	10.	11.	12.	14.	15.	16.	18.	20.	--	109
113	--	9.	11.	12.	13.	14.	16.	17.	20.	--	113
117	--	9.	10.	12.	13.	14.	15.	16.	19.	--	117
121	--	9.	10.	11.	12.	14.	15.	16.	18.	--	121
125	--	8.	10.	11.	12.	13.	14.	15.	18.	--	125

TABLE 6. PREDEFINED FILTERS

Filter No.	Filter Name	Normalized Upper Passband Frequency	Normalized Lower Stopband Frequency
1	LP050000	.05	.1
2	LP056123	.056123	.10875
3	LP062996	.062996	.1175
4	LP070711	.070711	.12875
5	LP079370	.07937	.14
6	LP089090	.08909	.1525
7	LP100000	.1	.16625
8	LP112246	.112246	.18125
9	LP125992	.125992	.1975
10	LP141421	.141421	.21625
11	LP158740	.15874	.23625
12	LP178180	.17818	.25875
13	LP200000	.2	.2825
14	LP224492	.224492	.31
15	LP251984	.251984	.34
16	LP282843	.282843	.37375
17	LP317480	.31748	.41125
18	LP356359	.356359	.4525
19	LP090000	.09	.125 ANTI-ALIAS 1:4
20	LP180000	.18	.25 ANTI-ALIAS 1:2

2.2.8 Constants Produced and Automatically Named by CM

Various Commands of the Validation Command Language produce various discrete quantities from time-varying quantities. These discrete quantities are called constants and stored with identifying names in a similar manner to time-varying quantities which are called variables. If more than one constant is produced by a command, the command language automatically generates and prints out names for the constants.

The generation of names is carried out by truncating the Dataname to six characters if it is longer than that and suffixing a fixed two character code. Table 7 contains the two character codes and a description of the codes for the various commands which create names.

Of the eight constants produced by the CM command, the confidence interval deserves comment. When the confidence interval is small with respect to the mean and variance, the implication is that the data set is normally distributed.

2.2.9 Four Special Indices (CH, CS, CG, and TM)

HIC, Severity Index, Modified Severity Index, and the Three Millisecond Average should normally be applied only to head accelerations although some of these indices are applied to chest accelerations. The computation of the four indices is discussed in Section 3.3.3.

The names produced by TM are presented in Table 7.

2.2.10 Constants for Compute Frequency (CF)

The Compute Frequency command is very similar to the Fourier Coefficients command except CF produces only two constants which represent the maximum coefficient and its corresponding frequency. This command will aid in manipulating any dominate coefficients. The names of the two constants can be constructed using Table 7.

2.2.11 Constants for Pointwise Means (PM)

The Pointwise Means command is included to aide in the reduction of data from replications or obtaining averages of kinematics over

TABLE 7. TWO CHARACTER SUFFIX NAME CODES

Command	Suffix Name Code	Constant Description
CF	CM	Maximum Coefficient
	FR	Frequency for maximum coefficient
CM	AX	Maximum
	CF	Confidence Interval
	ED	Median
	EN	Mean
	IN	Minimum
	NM	Number of points minus one
	OD	Mode
	VR	Variance
PM	AX	Maximum
	EN	Mean
	IN	Minimum
	VR	Variance
TM	AV	Three millisecond average
	IT	Leading time of interval
	PK	Peak value

body parts. Four constants are produced as well as the mean curve and these all refer to the mean curve The names of the constants can be constructed using Table 7.

2.2.12 Regression Fitting (RF)

The Regression Fitting command will compute coefficients for more than one degree polynomial. Goodness-of-fit statistics, a covariance matrix, or a regression analysis on the coefficients is not provided at this time. However, the "goodness-of-fit" can be examined by manually comparing the printed values of the computed polynomials with the input values and accepting or rejecting various fitted polynomials on the basis of the apparent residuals. At this time, neither the coefficient nor the computed values of the fitted polynomials are saved for later use.

2.2.13 Formula Interpreter (FI)

The FI command consists of a Name for the new constant or data set* to be created, three input parameters (start time, time increment, and final time), and a formula which is to be computed. The start time, time increment,and final time describe both the data set to be produced and the subset of time points which must be present in any non-constant data set named in the formula. If the Start time equals the Final time, a constant is created and any non-constant data set named is evaluated for this time. The formula must start in column one of the first line after the parameter specifications end. The formula must be contained on not more than ten consecutive eighty character lines. The formula consists of a string of subterms joined by binary operators (see Table 9) and ends with an "$E" . Each subterm consists of zero, one or two unary operators (see Table 8) followed by the name of the constant, the name of a data set, or a numeric quantity.

Each unary operator applies to the portion of the subterm which follows it. Table 8 defines the five unary operators.

---

* "Constant" implies a time-independent quantity or one time point. "Data set" implies a time-dependent quantity specified at least at two time points.

TABLE 8. UNARY OPERATORS

Operator	Function	Comments
$A	Take absolute value	No restrictions
$C	Take cosine of value	Value assumed in degrees
$M	Change sign of value	No restrictions
$Q	Take square root of absolute value	No restrictions
$S	Take sine of value	Value assumed in degrees

If the last unary operator of a subterm is followed by a sign, a number or a decimal point, a numerical quantity is expected and is of the form (S)(N...N)(.)(N...N), where "S" is "+" or "-". "N" is a decimal digit, and "." is a decimal point. "( )" indicates that what is enclosed is optional but must not be included in the specification. If a letter follows in this situation, a name of a constant or a data set is expected.

Table 9 defines the five binary operators.

TABLE 9. BINARY OPERATORS

Operator	Function	Comments
+	Addition	No restriction
-	Subtraction	No restriction
*	Multiplication	No restriction
/	Division	Subterm following must be non-zero
**	Exponentiation	Previous portion of term may need to be non-negative for some values of exponent

All evaluation of binary operators is from left to right. If the binary operator is addition or subtraction it marks the beginning of a new term. The other three operators always connect the part of the current term before the operator with the subterm which immediately follows the operator to continue building the current term. Evaluation of binary operators is from right to left with each subterm. The FI command may be used as many times as desired to build up a complex computation.

For example, consider the formula $a_r = \sqrt{a_x^2 + a_y^2}$ to be evaluated every ten msec. over a 200 msec run. Assume that the a_x values are in data set AX stored every msec and a_y values are in data set AY stored every five msec. The following two FI commands are required:

```
FI  ARSQ.
0,10,200*
AX*AX+AY*AY$E
FI AR.
0,10,200*
$QARSQ$E
```

The resultant is stored in data set AR and ARSQ contains the sum of squares.

2.2.14 Plots (SP, PQ, PC, PP)

The four plot commands are used and reused to produce printer plots of four basic kinds. The POLAR plot shows ratios of constants with respect to the unit circle and two limiting circles. Up to 26 pairs of quantities as are desired may be presented on one plot.

The CART plot reproduces one or more quantities versus time on a rectangular grid. The DEV plot is the difference of two curves shown around zero. The phase plot is two related variables plotted as a function of each other for all the time points present in the time subset.

2.3 Description Of Command Language Output

The Command Language produces four levels of output. Output directed to the interactive user which may be redirected to a batch printer in a batch environment. Output directed to a batch printer even when interactive communication is going on. Diagnostics directed to the interactive user when error conditions occur. Auxiliary output directed to the interactive user at his request to supplement the normal interactive printout. The next three sections describe these four categories of output briefly.

2.3.1 Interactive Output and Batch Output

Interactive output consists of items which are useful to see during an interactive session. These items include assigned names, verifications that what was supposed to happen did happen, and reminders of the values of certain quantities. The Batch Output consists of items which the user will want to see but not during the interactive session. These items include the complete printout of the regression fitting program and the print plots.

2.3.2 Diagnostics

Table10 lists the diagnostics printed by the Command Language, the routine which is involved in case debugging is necessary, the meaning of the diagnostic, and user action which is indicated. Table10 does not include diagnostics from the filter design package.

2.3.3 Auxiliary Output

The Auxiliary Output is all interactive and could be described as more of the same with reference to the Interactive Output. The Auxiliary Output essentially makes most commands act like Assessment Division Commands. Much of the information each command computes is printed out.

TABLE 10. DIAGNOSTICS

DIAGNOSTIC	CONDITION	ROUTINE NAME
CHARACTER = ______ IN COL. NO. = ________ IS ILLEGAL.	illegal character for numerical data	CONVER or PACK
FATAL ERROR --- INFO ARRAY FILLED, INCREASE DIMENSION.	info array too small for data expected (should not happen except for PTTINS if number of quantities is greater than 8)	
FILTER NAMED ______________ DOES NOT EXIST.	filter not designed yet and not on file under name as given.	FILTER
NUMBER OF HARMONICS TOO LARGE FOR NUMBER OF SAMPLE POINTS.	too many harmonics asked for	FOCOLS
QUANTITY NAMED ______________ NOT FOUND IN CONTROL STORAGE ARRAY.	quantity not known by name as given	GETEN
WARNING IN HIC PROGRAM --- TIME DURATION TOO SMALL.	input data not consistent with data set	HIC
FOR QUANTITY NAMED __________ START TIME ENTERED EXCEEDS FINAL TIME RECORDED.	final time too small or start time too large	HICC THREM
CARD NO. _________ HAS BEEN SKIPPED WITH ERROR TYPE = _________ AT POINTER = ______________.	error on input card	INMAIN
TOO MANY POINTS FOR PLOT.	more than 26 pairs of data for POLAR, more than 1 pair of curves for PHASE, more than 5 curves or pairs of curves for CART or DEV	INMAIN
VARIABLE SPECIFICATION ILLEGAL OR VARIABLE ABSENT ---- CATG. NO. = _________ COL. NO. = _____________ IDENTIFIERS = __________ ______________.	input data specifies variable which is not present or is illegal	INST
DATA FOR CATEGORY NUMBER _________ WAS NOT RECORDED.	this category of data is not available	MODAT
CATETORY NUMBER ENTERED IS ILLEGAL.	must be between 1 and 40	

TABLE 10. DIAGNOSTICS (Continued)

DIAGNOSTIC	CONDITION	ROUTINE NAME
WARNING --- VARIABLE POSITION SECTION PARAMETERS INCONSISTENT --- LEAD SEARCH RANGE PRE & POST = ____ ____ ____ CUR REC NO RANGE = ____ ____, NO. GRP/LINE = ____ NO./GRP = ____ NO. GRP = ____ LAST REC NO. READ = ____, VAL IND RANGE CUR LINE = ____ ____.	catch files from an MVMA 2-D run have been clobbered and are no longer readable	PICKUP
FOR QUANTITIES NAMED ____ AND ____ POLAR POINT IS OFFPAGE. POINT WILL BE INVERTED AND PLOTTED.	comment only	PLOTQT
QUANTITIES NAMED ____ AND ____ CANNOT BE PLOTTED AS ONE OF THEM IS ZERO.	comment only	PLOTQT
FILTER HAS NOT BEEN DESIGNED YET.	insufficient data for filter	SAVCOF
FATAL ERROR --- ILLEGAL ZERO IN LEAD (13).	catch files from an MVMA 2-D run clobbered	SEARCH
FATAL ERROR IN SEEKNM, ILLEGAL IDIR = ____ ____.		SEEKNM
FATAL ERROR IN SEEKNM, NO MATCH FOR REQUIRED PHRASE.	error in plot type asked for	
STOR ARRAY FILLED, INCREASE DIMENSION. KCON ARRAY FILLED, INCREASE DIMENSION.	too much data for storage	STOREN
OPERATOR NOT IDENTIFIED AS GIVEN, END ASSUMED.	illegal operator specified in formula	IDTFOP
SYMBOL IS NOT RECOGNIZED.	illegal character in formula	IDTFSM

2.4 Sample Input and Output

Four example runs are presented in this section. All four runs are artificial for the purpose of demonstrating most of the commands of the Command Language.

The first run is set up with: 1. the input stored in a data file (see Table 12), 2. the test data file which was read, set up in an input file (see Ta e 11); 3. Interactive and Auxiliary Output coming out over the teletype (see Table 13 pp. 1-4), and 4. the printer plots coming out to the batch printer (see Table 13 pp. 5-14). The input quantities are from two exercises of the MVMA 2-D model (Run A and Run B) and a completely artificial saw tooth wave presented as test data. This data is run through a selection of commands more or less in the order presented in Table 1. The output is largely self-explanatory -- the user is urged to follow it through.

Table 14 page 1 is the command data set for the second example. This example defines two data sets HEADA and HEADB which are the head resultant accelerations from the two MVMA 2-D Model Runs. Even though there are 101 time points in each, twenty-one time points are printed out. A new data set is created (HEADC) which has eleven time points based on the last one hundred milliseconds of the HEADA data set. A constant is created (HEADD) which is equal to the value of HEADA at time one hundred milliseconds. A new data set (DIFF) of twenty one points consists of the difference of a subset HEADA and HEADB. The formula interpreter is used to create a new data set (ANSW) which is computed as follows:

$$ANSW = 1.5\ (-HEADD) + \frac{2\quad HEADA}{-\quad HEADB} - DIFF - 1$$

Table 14 page 2 is the Interactive and Auxiliary Output for this example.

The third example designs a filter, checks it, stores it, and applies it on head acceleration data. One of the predefined filters is applied to the same data. The original data and the two filterings are printed. Then the two filterings are subtracted and one of them against the input data. MTS Fortran I/O allows a comma to be used as a field termination character. If the user's Fortran I/O does not allow this convenience, do not do as the example does (see example 4) because it is Fortran and not the Command Language which is doing it.

In this example, the input is truly interactive, but the output is treated the same way as the first example. Table 15 contains the Teletype Output followed by Batch Output for the second example. Again the output is self-explanatory.

The fourth example is a reworking of the first three examples and is run alone in a batch environment. The batch input, the batch output from the auxiliary output together with the regular batch output form Table 16. Note that the filter generation input is properly formatted.

TABLE 11. SAMPLE FILE TEST DATA

1	0.	10.	21	-1	1
2	(E10.0)				
3	5.				
4	4.				
5	3.				
6	2.				
7	1.				
8	0.				
9	1.				
10	2.				
11	3.				
12	4.				
13	5.				
14	6.				
15	7.				
16	8.				
17	9.				
18	10.				
19	9.				
20	8.				
21	7.				
22	6.				
23	5.				

```
CP.
1,200.,1*
PR NONE.
9*
TQ TESTV.
1,10.,200.*
MR.
1,2*
MQ HEADA.
6,3,2.,200.*
MQ CHESTA.
6,6,2.,200.*
MQ HIPA.
6,9,2.,200.*
MQ FCHA CHEST2                ISB
4,3,2.,200.*
MQ BELTA UPPER TORSO BELT
4,25,2.,200.*
MQ LOWERA.
11,4,2.,200.*
MQ UPPERA.
11,3,2.,200.*
MR.
3,4*
MQ HEADB.
6,3,2.,200.*
MQ CHESTB.
6,6,2.,200.*
MQ HIPB.
6,9,2.}200.*
MQ FCHB CHEST2                LSB
4,3,2.,200.*
MQ BELTB UPPER TORSO BELT
4,25,2.,200.*
MQ LOWERB.
11,4,2.,200.*
MQ UPPERB.
11,3,2.,200.*
RF TESTV.
0.,10.,200.,2,10,2,2*
QM TESTV.
OP FCHA FCHB.
100.,10.,150.,2.,100.,10.,150.,2.,20*
QA FCHA FCHB.
140.,2.,140.,2.,20,.8,.1,1.2*
FC HEADA.
0.,2.,200.,5*
SZ FCHA FCHAA.
140.,2.,200.*
SZ FCHB FCHBB.
140.,2.,200.*
CH HEADA HICA.
5,5,.85*
CH HEADB HICB.
5,5,.85*
CS CHESTA SIA.
0.,2.,200.*
CS CHESTB SIB.
0.,2.,200.*
```

TABLE 12. SAMPLE COMMAND LANGUAGE INPUT (Page 1)

```
CG CHESTA RSIA.
0.,2.,200.*
CG CHESTB RSIB.
0.,2.,200.*
CM HIPA.
0.,200.*
CM HIPB.
0.,200.*
CI FCHAA FCHAAI.
140.,200.*
CI FCHBB FCHBBI.
140.,200.*
CF HEADB.
50.,2.,150.,4*
TM HEADA.
0.,2.,200.*
TM HEADB.
0.,2.,200.*
MA TESTV TESTV2.
2.,0.,10.,200.*
CC BELTA BELTB BELTC.
0.,2.,200.,0.,2.*
CV HIPA HIPB.
PA LOWERA UPPERA LOWERB UPPERB VEL.
0.,2.,200.*
SP PRINT POLAR.
.2,.2,.2*
PQ HICA HICB.
10.*
PQ SIA SIB.
46.*
PQ RSIA RSIB.
82.*
PQ HIPAIR HIPAAX.
118.*
PQ FCHAAI FCHBBI.
154.*
PQ RSIA SIA.
190.*
PQ RSIB SIB.
226.*
PQ HEADAPK HEADBPK.
262.*
PQ HEADAAV HEADBAV.
298.*
PQ VELAX VELIN.
334.*
PP.
SP PRINT PHASE.
100.,0.,0.,15000.*
PC FCHA CHESTA.
PP.
SP PRINT CART.
200.,-1000.,600.*
PC VEL.
PC UPPERA.
PP.
SP PRINT DEV.
200.,-8000.,8000.*
PC BELTA BELTB.
```

TABLE 12. SAMPLE COMMAND LANGUAGE INPUT (Page 2)

```
PC FCHAA FCHBB.
PP.
PS BELTC.
TP TESTV1.
0.,10.,200.*
END OF FILE
```

TABLE 12. SAMPLE COMMAND LANGUAGE INPUT (Page 3)

```
*$RUN OFF 5*DATA 6=*PRINT* 7=*SINK* 8=FILTAB 9=TDAT 1=G8 2=G9 3=H8 4=H9
*EXECUTION BEGINS
 DEFAULT FINAL TIME IS RESET TO 200.0 MSEC
 OUTPUT QUANTITIES FOR THIS RUN ARE IN  METRIC  UNITS.
 LOGICAL DEVICE NUMBER FOR TEST DATA IS  9
 TEST QUANTITY NAMED TESTV    FROM    0.0 TO 200.0 AT   10.0 MSEC INTERVALS.
 NEXT FOUR LINES CONTAIN MODEL RUN DESCRIPTION
   MVMA 2-D MAN MODEL RUN A


                                              MVMA 2-D, VER. 3
 JUL  8, 197600:04:29
 QUANTITIES FROM THIS RUN ARE IN  METRIC  UNITS.
 FINAL TIME RECORDED IS 200.0 MSEC TIME INCREMENT IS    2.0 MSEC
 ACTUAL NUMBER OF POINTS IS 101. NUMBER OF ELLIPSES = 15, OF LINES =  7
 OF REGIONS = 10, OF INTERACTIONS = 14
      UNFILTERED ACCELS               HEAD        RESULTNT
 MODEL QUANTITY NAMED  HEADA   FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS.
      UNFILTERED ACCELS              CHEST        RESULTNT
 MODEL QUANTITY NAMED  CHESTA  FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS.
      UNFILTERED ACCELS               HIP         RESULTNT
 MODEL QUANTITY NAMED   HIPA   FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS.
 ELL-LIN:CHEST2            VS LSB                NM FORCE
 MODEL QUANTITY NAMED   FCHA   FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS.
 BLT-ATH:UPPER TORSO BELT VS                       A-P
 MODEL QUANTITY NAMED  BELTA   FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS.
      BODY LINK ANG VEL              MIDDLE        TORSO
 MODEL QUANTITY NAMED  LOWERA  FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS.
      BODY LINK ANG VEL              UPPER         TORSO
 MODEL QUANTITY NAMED  UPPERA  FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS.
 NEXT FOUR LINES CONTAIN MODEL RUN DESCRIPTION
   MVMA 2-D MAN MODEL RUN B
               \

                                              MVMA 2-D, VER. 3
 JUL  8, 197600:07:11
 QUANTITIES FROM THIS RUN ARE IN  METRIC  UNITS.
 FINAL TIME RECORDED IS 200.0 MSEC TIME INCREMENT IS    2.0 MSEC
 ACTUAL NUMBER OF POINTS IS 101. NUMBER OF ELLIPSES = 15, OF LINES =  6
 OF REGIONS =  9, OF INTERACTIONS = 14
      UNFILTERED ACCELS               HEAD        RESULTNT
 MODEL QUANTITY NAMED  HEADB   FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS.
      UNFILTERED ACCELS              CHEST        RESULTNT
 MODEL QUANTITY NAMED  CHESTB  FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS.
      UNFILTERED ACCELS               HIP         RESULTNT
 MODEL QUANTITY NAMED   HIPB   FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS.
 ELL-LIN:CHEST2            VS LSB                NM FORCE
 MODEL QUANTITY NAMED   FCHB   FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS.
 BLT-ATH:UPPER TORSO BELT VS                       A-P
 MODEL QUANTITY NAMED  BELTB   FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS.
      BODY LINK ANG VEL              MIDDLE        TORSO
 MODEL QUANTITY NAMED  LOWERB  FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS.
      BODY LINK ANG VEL              UPPER         TORSO
 MODEL QUANTITY NAMED  UPPERB  FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS.
```

TABLE 13. SAMPLE INTERACTIVE AND AUXILIARY OUTPUT FOLLOWED BY BATCH OUTPUT (Page 1)

I	X	Y	DEGREE 2 FIT	DEGREE 3 FIT
1	0.0	5.00	1.75	5.70
2	0.01	4.00	2.08	3.66
3	0.02	3.00	2.40	2.24
4	0.03	2.00	2.73	1.37
5	0.04	1.00	3.05	0.99
6	0.05	0.0	3.38	1.02
7	0.06	1.00	3.70	1.40
8	0.07	2.00	4.03	2.06
9	0.08	3.00	4.35	2.92
10	0.09	4.00	4.68	3.93
11	0.10	5.00	5.00	5.00
12	0.11	6.00	5.32	6.07
13	0.12	7.00	5.65	7.08
14	0.13	8.00	5.97	7.94
15	0.14	9.00	6.30	8.60
16	0.15	10.00	6.62	8.98
17	0.16	9.00	6.95	9.01
18	0.17	8.00	7.27	8.63
19	0.18	7.00	7.60	7.76
20	0.19	6.00	7.92	6.34
21	0.20	5.00	8.25	4.30

I	DEGREE 4 FIT	DEGREE 5 FIT	DEGREE 6 FIT	DEGREE 7 FIT
1	5.69	5.26	5.21	5.22
2	3.66	3.30	3.86	3.86
3	2.24	2.65	2.67	2.66
4	1.38	1.67	1.75	1.74
5	0.99	1.06	1.15	1.15
6	1.02	0.87	0.93	0.94
7	1.40	1.10	1.11	1.12
8	2.06	1.71	1.66	1.67
9	2.92	2.63	2.53	2.54
10	3.92	3.77	3.66	3.66
11	4.99	5.02	4.93	4.93
12	6.07	6.27	6.23	6.23
13	7.07	7.40	7.43	7.42
14	7.94	8.30	8.39	8.39
15	8.60	8.89	9.02	9.02
16	8.98	9.10	9.22	9.22
17	9.02	8.90	8.94	8.95
18	8.64	8.29	8.22	8.23
19	7.77	7.32	7.16	7.15
20	6.34	6.10	5.96	5.95
21	4.29	4.80	4.97	4.97

I	DEGREE 8 FIT	DEGREE 9 FIT	DEGREE 10 FIT	DEGREE
1	5.19	5.31	5.26	
2	3.89	3.21	3.81	
3	2.69	2.57	2.62	
4	1.74	1.67	1.73	
5	1.13	1.14	1.19	
6	0.92	0.99	0.93	
7	1.11	1.21	1.15	
8	1.67	1.76	1.68	
9	2.55	2.59	2.53	
10	3.67	3.65	3.63	
11	4.93	4.86	4.89	
12	6.22	6.12	6.19	
13	7.41	7.32	7.40	
14	8.38	8.34	8.40	
15	9.02	9.06	9.05	
16	9.23	9.33	9.25	
17	8.97	9.08	8.98	
18	8.24	8.28	8.23	
19	7.16	7.07	7.13	
20	5.95	5.78	5.91	
21	5.01	5.09	5.00	

TABLE 13. SAMPLE INTERACTIVE AND AUXILIARY OUTPUT FOLLOWED BY BATCH OUTPUT (Page 2)

```
FOR QUANTITY NAMED  TESTV   MEASURES ARE: MIN =     0.0    , MAX =   10.0000
MEAN =     5.0000, VARIANCE =     8.0952, MODE =     5.0000, MEDIAN =     5.0000
FOR QUANTITIES NAMED   FCHA   AND   FCHB
PHASE CORRELATION COEFFICIENT IS     0.9909
START TIME FOR FIRST QUANTITY IS 130.0 AND FOR SECOND IS 120.0 MSEC.
START TIME SHIFTED FROM    0.0 TO 140.0 MSEC
START TIME SHIFTED FROM    0.0 TO 140.0 MSEC
FOR QUANTITIES NAMED   FCHA   AND   FCHB
AMPLITUDE CORRELATION COEFFICIENT IS     0.8278 WITH FACTOR OF    1.1000
FOR QUANTITY NAMED  HEADA   FOURIER COEFFICIENTS ARE   27.738
   -5.375  -14.820   -8.975   -3.450    0.252  -10.226   12.783   -7.498
   -4.479   -1.664
START TIME IS    0.0 TIME INTERVAL IS   2.0 PERIOD IS 200.0 MSEC.
NUMBER OF HARMONICS IS   5 BASIC FREQUENCY IS    5.0000 CPS.
START TIME SHIFTED FROM    0.0 TO 140.0 MSEC
QUANTITY NAMED   FCHA  , STARTING TIME SHIFTED FROM   0.0 TO 140.0 MSEC
RENAMED  FCHAA
START TIME SHIFTED FROM    0.0 TO 140.0 MSEC
QUANTITY NAMED   FCHB  , STARTING TIME SHIFTED FROM   0.0 TO 140.0 MSEC
RENAMED  FCHBB
FOR QUANTITY NAMED  HEADA   H.I.C. INDEX =      990.9 WITH T1,T2= 0.0300 0.2000
FOR QUANTITY NAMED  HEADB   H.I.C. INDEX =     1325.9 WITH T1,T2= 0.0400 0.2000
FOR QUANTITY NAMED  CHESTA  FROM    0.0 TO 200.0 AT    0.0 MSEC INTERVALS
SEVERITY INDEX HAS VALUE  836.8630
FOR QUANTITY NAMED  CHESTB  FROM    0.0 TO 200.0 AT    0.0 MSEC INTERVALS
SEVERITY INDEX HAS VALUE  905.3787
FOR QUANTITY NAMED  CHESTA  FROM    0.0 TO 200.0 AT    0.0 MSEC INTERVALS
MODIFIED SEVERITY INDEX HAS VALUE  445.1873
FOR QUANTITY NAMED  CHESTB  FROM    0.0 TO 200.0 AT    0.0 MSEC INTERVALS
MODIFIED SEVERITY INDEX HAS VALUE  475.4622
NEW NAMES ARE:  HIPAAX   HIPAIN   HIPAEN   HIPAVR   HIPACF   HIPAOD   HIPAED
 HIPANM
FOR QUANTITY NAMED   HIPA   MEASURES ARE: MIN =     0.4546, MAX =   69.6613
MEAN =   16.3218, VARIANCE =  137.6424, MODE =   18.2967, MEDIAN =   15.2332
CONFIDENCE INTERVAL =   22.7018
NEW NAMES ARE:  HIPBAX   HIPBIN   HIPBEN   HIPBVR   HIPBCF   HIPBOD   HIPBED
 HIPBNM
FOR QUANTITY NAMED   HIPB   MEASURES ARE: MIN =     0.8067, MAX =   81.5761
MEAN =   16.7169, VARIANCE =  162.2865, MODE =   10.4313, MEDIAN =   14.3802
CONFIDENCE INTERVAL =   26.7664
FOR QUANTITY NAMED  FCHAA   FROM 140.0 TO 200.0 AT   2.0 MSEC INTERVALS,
INTEGRAL IS  148.2343
FOR QUANTITY NAMED  FCHBB   FROM 140.0 TO 200.0 AT   2.0 MSEC INTERVALS,
INTEGRAL IS  179.2830
NEW NAMES ARE: HEADBFR  HEADBCM
START TIME SHIFTED FROM    0.0 TO   50.0 MSEC
QUANTITY NAMED  HEADB   FROM  50.0 TO 150.0 AT   2.0 MSEC INTERVALS
HAS FREQUENCY    0.0    WITH COEFFICIENT   33.3566
RENAMED RESPECTIVELY HEADBFR  AND HEADBCM
NEW NAMES ARE: HEADAPK  HEADAAV  HEADAIT
FOR QUANTITY NAMED  HEADA   PEAK VALUE IS   67.6011 AT 0.1760 SEC.
THREE MILLISECOND AVERAGE IS   67.0370
NEW NAMES ARE: HEADBPK  HEADBAV  HEADBIT
FOR QUANTITY NAMED  HEADB   PEAK VALUE IS   91.7661 AT 0.1780 SEC.
THREE MILLISECOND AVERAGE IS   88.8342
QUANTITY NAMED  TESTV   FROM    0.0 TO 200.0 AT  10.0 MSEC INTERVALS
HAS BEEN MULTIPLIED BY   2.000 AND RENAMED  TESTV2
FOR QUANTITIES NAMED  BELTA   AND  BELTB
CORRELATION COEFFICIENT IS     0.9522 RENAMED  BELTC
NEW NAMES ARE:  HIPAVR   HIPANM
NEW NAMES ARE:  HIPBVR   HIPBNM
FOR QUANTITIES NAMED   HIPA   AND   HIPB   F AND F2 =    1.1790    5.5600
VARIANCES ARE THE SAME.
NEW NAMES ARE:  VELAX    VELIN    VELEN    VELVR
FOR QUANTITIES NAMED  LOWERA ,  UPPERA ,  LOWERB ,  UPPERB ,
MEAN CURVE STORED AS   VEL
POINTWISE MEASURES ARE: MAX =  554.0393, MIN = -758.5210, MEAN =  -37.2014
VARIANCE = 133445.6875
```

TABLE 13. SAMPLE INTERACTIVE AND AUXILIARY OUTPUT FOLLOWED BY BATCH OUTPUT (Page 3)

```
FOR POLAR PLOT, REFERENCE LINES ARE 0.200 BELOW AND 0.200 ABOVE 1.
SCALING PARAMETERS ARE:    -1.4000     1.4000     1.4000    -1.4000     3.2143
   32.1429   67.0000  -19.2857   28.0000    0.0156    0.0259    0.3111
FOR QUANTITIES NAMED   HICA   AND   HICB    WITH VALUES     990.8682   1325.9229
POLAR POINT IS AT X,Y=    0.7360     0.1298 LABELED A
FOR QUANTITIES NAMED   SIA    AND   SIB     WITH VALUES     836.8630    805.3787
POLAR POINT IS AT X,Y=    0.7218     0.7475 LABELED B
FOR QUANTITIES NAMED   MSIA   AND   MSIB    WITH VALUES     445.1873    475.4622
POLAR POINT IS AT X,Y=    0.1303     0.9272 LABELED C
FOR QUANTITIES NAMED  HIPAIN  AND  HIPAAX   WITH VALUES       0.4546     69.6613
POLAR POINT IS AT X,Y=    0.0031    -0.0058 LABELED D
FOR QUANTITIES NAMED  FCHAAI  AND  FCHBBI   WITH VALUES     148.3343    179.2830
POLAR POINT IS AT X,Y=   -0.7436     0.3627 LABELED E
FOR QUANTITIES NAMED   MSIA   AND   SIA     WITH VALUES     445.1873    836.8630
POLAR POINT IS AT X,Y=   -0.5239    -0.0924 LABELED F
FOR QUANTITIES NAMED   MSIB   AND   SIB     WITH VALUES     475.4622    805.3787
POLAR POINT IS AT X,Y=   -0.4101    -0.4247 LABELED G
FOR QUANTITIES NAMED HEADAPK  AND HEADBPK   WITH VALUES      67.6011     91.7661
POLAR POINT IS AT X,Y=   -0.1025    -0.7295 LABELED H
FOR QUANTITIES NAMED HEADAAV  AND HEADBAV   WITH VALUES      67.0370     88.8342
POLAR POINT IS AT X,Y=    0.3543    -0.6663 LABELED I
FOR QUANTITIES NAMED  VELAX   AND  VELEN    POLAR POINT IS OFF PAGE.
POINT WILL BE INVERTED AND PLOTTED.
FOR QUANTITIES NAMED  VELEN   AND  VELAX    WITH VALUES     -37.2014    554.0393
POLAR POINT IS AT X,Y=    0.0604    -0.0294 LABELED J
FOR PHASE PLANE TYPE PLOT,
SCALING PARAMETERS ARE:    0.0    15000.0000  100.0000    0.0
    0.0087    2.0000   -0.5400    55.0000    57.6923    0.9259
FOR CARTESIAN PLOT,
SCALING PARAMETERS ARE:     0.0      200.0000  600.0000-1000.0000
    0.6500    2.0000   -0.0337    21.2500    0.7692   14.8148
FOR DEVIATION PLOT,
SCALING PARAMETERS ARE:     0.0      200.0000 8000.0000-9000.0000
    0.6500    2.0000   -0.0034    28.0000    0.7692   148.1481
QUANTITY NAMED  BELTC   HAS VALUE        0.95221156
FOR QUANTITY NAMED  TESTV2  FROM     0.0 TO 200.0 AT   10.0 MSEC INTERVALS
VALUES ARE              10.000000          8.0000000          6.0000000
    4.0000000          2.0000000          0.0                2.0000000
    4.0000000          6.0000000          8.0000000          10.000000
    12.000000          14.000000          16.000000          18.000000
    20.000000          18.000000          16.000000          14.000000
    12.000000          10.000000
```

TABLE 13. SAMPLE INTERACTIVE AND AUXILIARY OUTPUT FOLLOWED BY BATCH OUTPUT (Page 4)

VALIDATION COMMAND LANGUAGE PROGRAM PAGE 1

OUTPUT OF INPUT

COEFFICIENTS A(I) FOR APPROXIMATING POLYNOMIAL F OF DEGREE N

$$F(X) = A(0) + A(1)X + A(2)X^{2} + A(3)X^{3} + \ldots + A(I)X^{I} + \ldots + A(N)X^{N}$$

I	N = 2	N = 3	N = 4	N = 5	N = 6	N = 7	N = 8	N = 9	N =10	N =
0	0.175324E+01	0.570438E+01	0.569353E+01	0.526287E+01	0.520785E+01	0.522049E+01	0.519149E+01	0.531051E+01	0.525537E+01	
1	0.324675E+02	-0.238116E+03	-0.236813E+03	-0.134194E+03	-0.139385E+03	-0.141078E+03	-0.129272E+03	-0.159546E+03	-0.155051E+03	
2	0.506642E-03	0.346612E+04	0.343600E+04	-0.596911E+03	0.266535E+03	0.270173E+03	-0.480166E+03	0.712497E+03	0.984781E+03	
3	0.0	-0.115539E+05	-0.113201E+05	0.450621E+05	0.192877E+05	0.213362E+05	0.396959E+05	0.259085E+05	0.105037E+05	
4	0.0	0.0	-0.577598E+03	-0.324456E+06	-0.253345E+05	-0.745233E+05	-0.284647E+06	-0.280262E+06	-0.692184E+05	
5	0.0	0.0	0.0	0.652741E+06	-0.849323E+06	-0.384337E+06	0.712915E+06	0.146849E+07	0.855198E+06	
6	0.0	0.0	0.0	0.0	0.273423E+07	0.754996E+06	-0.615500E+06	-0.448744E+07	-0.988187E+07	
7	0.0	0.0	0.0	0.0	0.0	0.315452E+07	-0.505863E+07	0.423176E+07	0.221178E+08	
8	0.0	0.0	0.0	0.0	0.0	0.0	0.229512E+08	-0.285314E+08	0.153509E+09	
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.157207E+09	-0.829451E+09	
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.122505E+10	

I	X	Y	DEGREE 2 FIT	DEGREE 3 FIT	DEGREE 4 FIT	DEGREE 5 FIT	DEGREE 6 FIT
1	0.0	5.00	1.75	5.70	5.69	5.26	5.21
2	0.01	4.00	2.08	3.66	3.66	3.90	3.86
3	0.02	3.00	2.40	2.24	2.24	2.65	2.67
4	0.03	2.00	2.73	1.37	1.38	1.67	1.75
5	0.04	1.00	3.05	0.99	0.99	1.06	1.15
6	0.05	0.0	3.38	1.02	1.02	0.87	0.93
7	0.06	1.00	3.70	1.40	1.40	1.10	1.11
8	0.07	2.00	4.03	2.06	2.06	1.71	1.66
9	0.08	3.00	4.35	2.92	2.92	2.63	2.53
10	0.09	4.00	4.68	3.93	3.92	3.77	3.66
11	0.10	5.00	5.00	5.00	4.99	5.02	4.93
12	0.11	6.00	5.32	6.07	6.07	6.27	6.23
13	0.12	7.00	5.65	7.08	7.07	7.40	7.43
14	0.13	8.00	5.97	7.94	7.94	8.30	8.39
15	0.14	9.00	6.30	8.60	8.60	8.89	9.02
16	0.15	10.00	6.62	8.98	8.98	9.10	9.22
17	0.16	9.00	6.95	9.01	9.02	8.90	8.94
18	0.17	8.00	7.27	8.63	8.64	8.29	8.22
19	0.18	7.00	7.60	7.76	7.77	7.32	7.16
20	0.19	6.00	7.92	6.34	6.34	6.10	5.96
21	0.20	5.00	8.25	4.30	4.29	4.80	4.97

I	X	Y	DEGREE 7 FIT	DEGREE 8 FIT	DEGREE 9 FIT	DEGREE 10 FIT	DEGREE
1	0.0	5.00	5.22	5.19	5.31	5.26	
2	0.01	4.00	3.86	3.89	3.81	3.81	
3	0.02	3.00	2.66	2.69	2.57	2.62	
4	0.03	2.00	1.74	1.74	1.67	1.73	
5	0.04	1.00	1.15	1.13	1.14	1.18	
6	0.05	0.0	0.94	0.92	0.99	0.98	
7	0.06	1.00	1.12	1.11	1.21	1.15	
8	0.07	2.00	1.67	1.67	1.76	1.68	
9	0.08	3.00	2.54	2.55	2.59	2.53	
10	0.09	4.00	3.66	3.67	3.65	3.63	
11	0.10	5.00	4.93	4.93	4.86	4.89	
12	0.11	6.00	6.22	6.22	6.12	6.19	
13	0.12	7.00	7.42	7.41	7.32	7.40	
14	0.13	8.00	8.39	8.38	8.34	8.40	

TABLE 13. SAMPLE INTERACTIVE AUXILIARY OUTPUT FOLLOWED BY BATCH OUTPUT (Page 5)

VALIDATION COMMAND LANGUAGE PROGRAM PAGE 2

OUTPUT OF INPUT

I	X	Y	DEGREE 7 FIT	DEGREE 8 FIT	DEGREE 9 FIT	DEGREE 10 FIT	DEGREE
15	0.14	9.00	9.02	9.02	9.06	9.05	
16	0.15	10.00	9.22	9.23	9.33	9.25	
17	0.16	9.00	8.95	8.97	9.08	8.98	
18	0.17	8.00	8.23	8.24	8.28	8.23	
19	0.18	7.00	7.15	7.16	7.07	7.13	
20	0.19	6.00	5.95	5.95	5.78	5.91	
21	0.20	5.00	4.97	5.01	5.09	5.00	

TABLE 13. SAMPLE INTERACTIVE AND AUXILIARY OUTPUT FOLLOWED BY BATCH OUTPUT (Page 6)

```
                    VALIDATION COMMAND LANGUAGE PROGRAM  PAGE  3

                                   POLAR PLOT

EXPLANATION OF CHARACTERS ON PLOT

A =    HICA     DIVIDED BY    HICB     WITH VALUE     0.7473
B =    SIA      DIVIDED BY    SIB      WITH VALUE     1.0391
C =    MSIA     DIVIDED BY    MSIB     WITH VALUE     0.9363
D =   HIPAIN    DIVIDED BY   HIPAAX    WITH VALUE     0.0065
E =   FCHAAI    DIVIDED BY   FCHBBI    WITH VALUE     0.8274
F =    MSIA     DIVIDED BY    SIA      WITH VALUE     0.5320
G =    MSIB     DIVIDED BY    SIB      WITH VALUE     0.5964
H =  HEADAPK    DIVIDED BY  HEADBPK    WITH VALUE     0.7367
I =  HEADAAV    DIVIDED BY  HEADBAV    WITH VALUE     0.7546
J =   VELEN     DIVIDED BY   VELAX     WITH VALUE    -0.0671
```

TABLE 13. SAMPLE INTERACTIVE AND AUXILIARY OUTPUT FOLLOWED BY BATCH OUTPUT (Page 7)

VALIDATION COMMAND LANGUAGE PROGRAM PAGE 4

POLAR PLOT

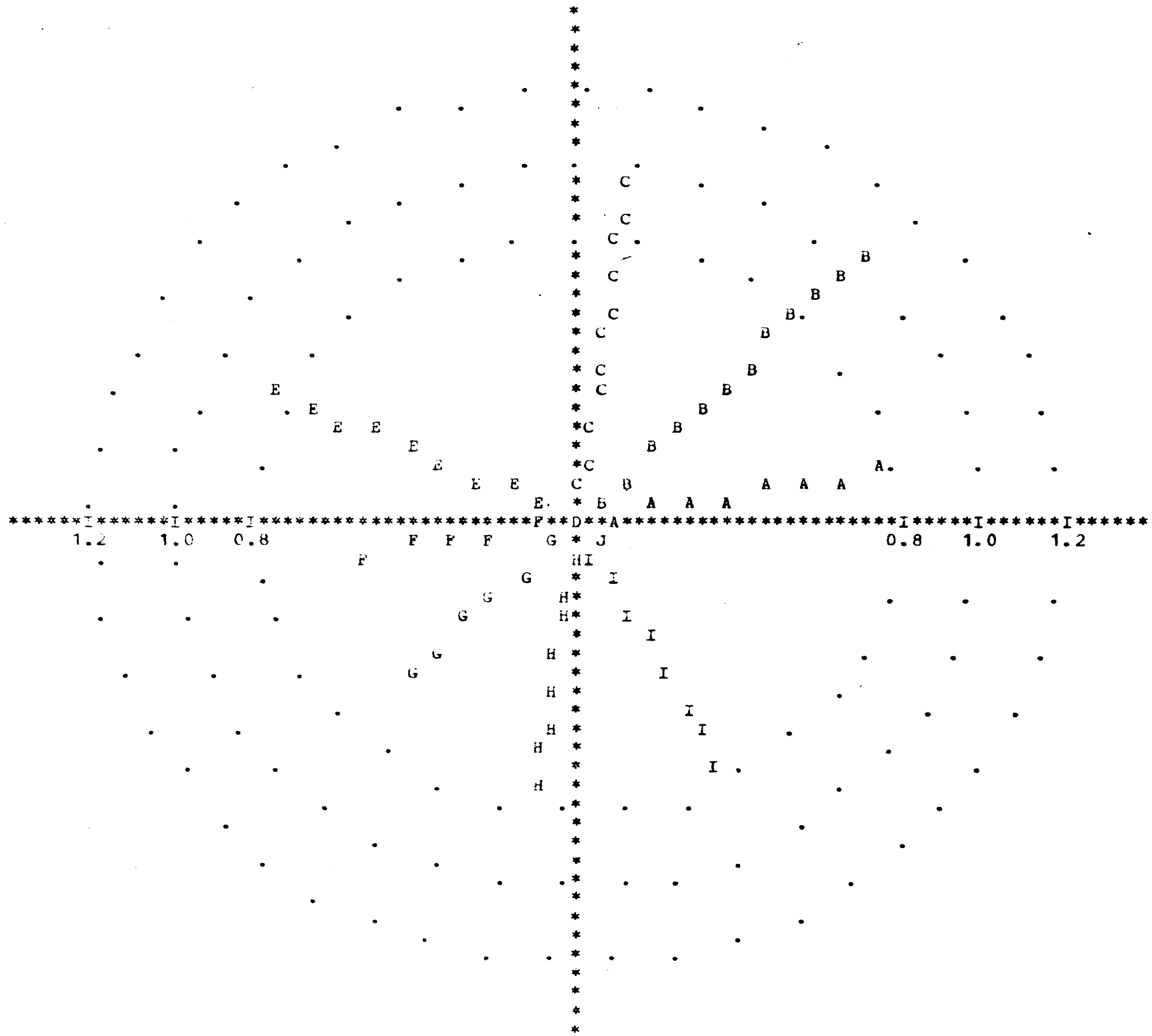

TABLE 13. SAMPLE INTERACTIVE AND AUXILIARY OUTPUT FOLLOWED BY BATCH OUTPUT (Page 8)

PHASE PLANE TYPE PLOT

FCHA AS Y VERSUS CLESTA AS X.

INDEX	TIME	X	Y	INDEX	TIME	X	Y	INDEX	TIME	X	Y	INDEX	TIME	X	Y
1	0.0	0.0	0.4903	27	52.0	0.0	23.7441	53	104.0	0.0	24.0981	79	156.0	1029.2327	10.2070
2	2.0	0.0	4.6230	28	54.0	0.0	25.8193	54	106.0	0.0	21.9454	80	158.0	1552.5078	15.0924
3	4.0	0.0	5.0312	29	56.0	0.0	27.4693	55	108.0	0.0	19.7535	81	160.0	2505.3455	19.5635
4	6.0	0.0	4.7839	30	58.0	0.0	29.4659	56	110.0	0.0	17.6475	82	162.0	4053.1379	33.5560
5	8.0	0.0	6.5958	31	60.0	0.0	30.9533	57	112.0	0.0	14.9579	83	164.0	6108.3711	46.0893
6	10.0	0.0	4.8821	32	62.0	0.0	32.0579	58	114.0	0.0	11.4165	84	166.0	8273.2461	61.7612
7	12.0	0.0	5.7707	33	64.0	0.0	33.0549	59	116.0	0.0	8.1227	85	168.0	9843.5039	75.5641
8	14.0	0.0	7.1506	34	66.0	0.0	34.6094	60	118.0	0.0	5.1593	86	170.0	10109.1484	80.0315
9	16.0	0.0	7.4559	35	68.0	0.0	30.4383	61	120.0	0.0	5.7757	87	172.0	8921.3477	60.8688
10	18.0	0.0	8.5690	36	70.0	0.0	29.8415	62	122.0	0.0	9.9045	88	174.0	6538.5977	41.4099
11	20.0	0.0	9.6271	37	72.0	0.0	35.6653	63	124.0	0.0	10.0032	89	176.0	3315.7734	27.4307
12	22.0	0.0	10.3804	38	74.0	0.0	35.3123	64	126.0	0.0	8.4641	90	178.0	1480.8242	15.7101
13	24.0	0.0	11.0797	39	76.0	0.0	35.4235	65	128.0	0.0	7.5518	91	180.0	1352.2383	10.6330
14	26.0	0.0	11.6465	40	78.0	0.0	34.7423	66	130.0	0.0	7.1602	92	182.0	1217.0308	4.5510
15	28.0	0.0	12.2114	41	80.0	0.0	33.7050	67	132.0	0.0	6.7313	93	184.0	1080.3774	7.3792
16	30.0	0.0	13.0509	42	82.0	0.0	32.6543	68	134.0	0.0	7.0419	94	186.0	946.0515	16.1921
17	32.0	0.0	14.1304	43	84.0	0.0	32.6856	69	136.0	0.0	8.5886	95	188.0	818.3242	22.5625
18	34.0	0.0	15.1298	44	86.0	0.0	32.8794	70	138.0	0.0	9.3883	96	190.0	700.5403	25.8059
19	36.0	0.0	16.1663	45	88.0	0.0	32.5149	71	140.0	0.0	11.6105	97	192.0	594.1235	25.9751
20	38.0	0.0	17.2394	46	90.0	0.0	33.5299	72	142.0	69.0192	13.9412	98	194.0	499.3674	24.1450
21	40.0	0.0	18.2367	47	92.0	0.0	35.8933	73	144.0	161.1398	10.3320	99	196.0	415.4136	22.8289
22	42.0	0.0	14.0720	48	94.0	0.0	41.7513	74	146.0	254.6586	9.6975	100	198.0	342.2168	24.1671
23	44.0	0.0	15.1915	49	96.0	0.0	40.0335	75	148.0	357.9053	7.4119	101	200.0	280.7485	25.1228
24	46.0	0.0	16.9546	50	98.0	0.0	36.1482	76	150.0	465.8789	7.0181				
25	48.0	0.0	19.2131	51	100.0	0.0	39.1593	77	152.0	583.6179	7.1919				
26	50.0	0.0	21.4295	52	102.0	0.0	29.0964	78	154.0	746.2722	8.1855				
27	52.0	0.0	23.7441	53	104.0	0.0	24.0981	79	156.0	1029.2327	10.2070				

TABLE 13. SAMPLE INTERACTIVE AND AUXILIARY OUTPUT FOLLOWED BY BATCH OUTPUT (Page 9)

VALIDATION COMMAND LANGUAGE PROGRAM PAGE 6

PHASE PLANE TYPE PLOT

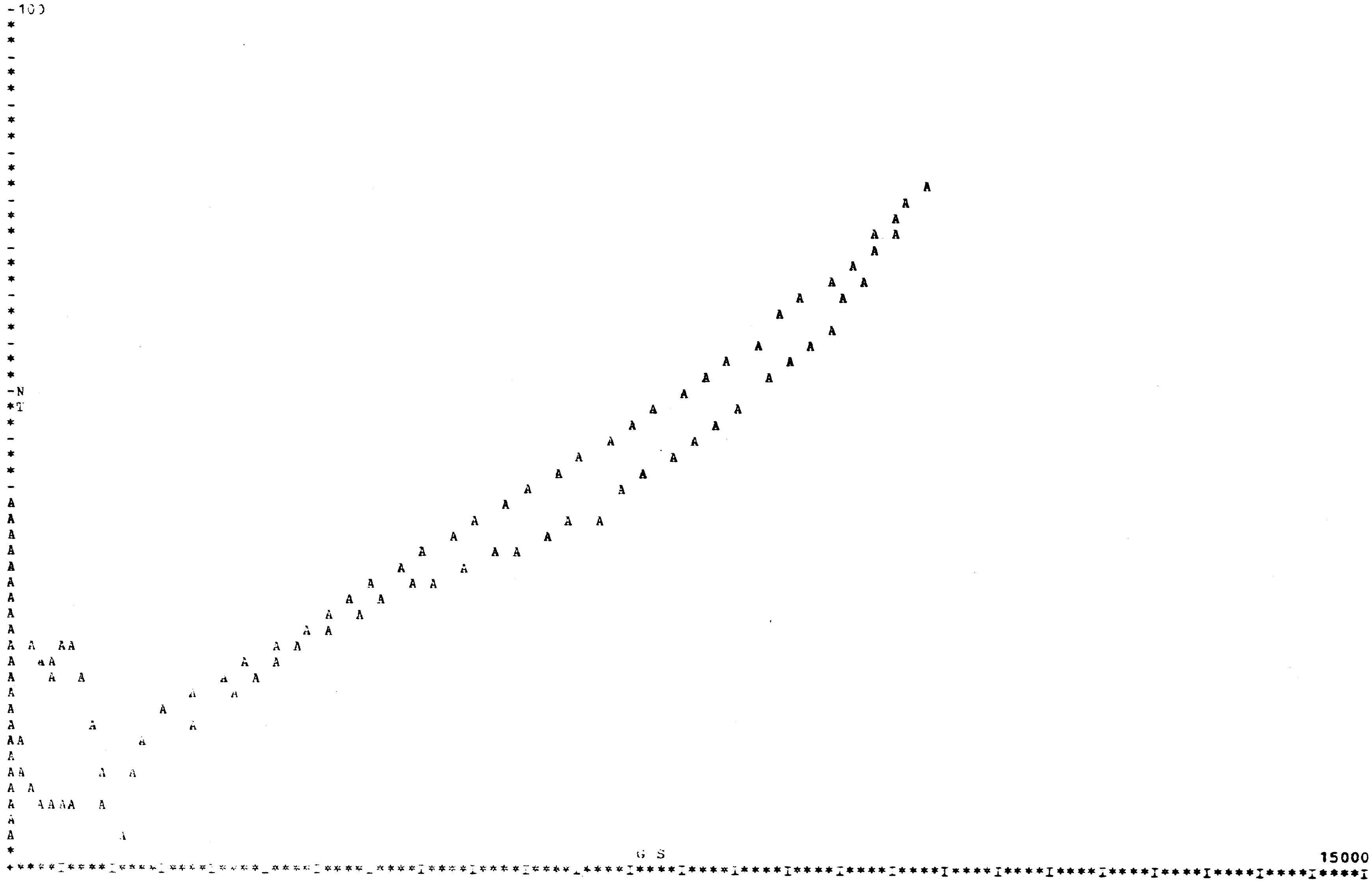

TABLE 13. SAMPLE INTERACTIVE AND AUXILIARY OUTPUT FOLLOWED BY BATCH OUTPUT (Page 10)

VALIDATION COMMAND LANGUAGE PROGRAM PAGE 7

CARTESIAN PLOT

VEL VERSUS TIME LABELED A

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
0.0	0.0	26.0	-111.858	52.0	-526.690	78.0	-66.627	104.0	322.220	130.0	456.909	156.0	274.716	182.0	-643.051
2.0	0.0	28.0	-132.093	54.0	-537.286	80.0	10.838	106.0	369.944	132.0	457.998	158.0	255.249	184.0	-578.301
4.0	0.0	30.0	-156.213	56.0	-546.420	82.0	49.747	108.0	418.872	134.0	453.692	160.0	248.895	186.0	-507.877
6.0	0.0	32.0	-188.243	58.0	-545.352	84.0	74.162	110.0	457.734	136.0	450.946	162.0	214.377	188.0	-422.833
8.0	0.0	34.0	-210.999	60.0	-541.603	86.0	59.633	112.0	494.934	138.0	440.853	164.0	155.286	190.0	-352.038
10.0	0.0	36.0	-242.468	62.0	-528.552	88.0	32.480	114.0	526.106	140.0	425.331	166.0	34.344	192.0	-282.626
12.0	0.0	38.0	-280.236	64.0	-504.800	90.0	51.591	116.0	548.265	142.0	406.385	168.0	-133.187	194.0	-224.691
14.0	0.0	40.0	-324.226	66.0	-482.142	92.0	61.176	118.0	554.039	144.0	383.541	170.0	-329.134	196.0	-178.617
16.0	0.0	42.0	-357.939	68.0	-445.158	94.0	42.258	120.0	550.537	146.0	367.413	172.0	-523.982	198.0	-121.307
18.0	0.0	44.0	-399.668	70.0	-390.063	96.0	44.044	122.0	527.476	148.0	360.026	174.0	-660.428	200.0	-57.964
20.0	0.0	46.0	-438.982	72.0	-316.311	98.0	87.738	124.0	498.213	150.0	342.926	176.0	-748.940		
22.0	0.0	48.0	-474.727	74.0	-241.666	100.0	175.311	126.0	478.696	152.0	322.142	178.0	-758.521		
24.0	0.0	50.0	-507.365	76.0	-159.083	102.0	268.289	128.0	462.726	154.0	299.923	180.0	-712.324		
26.0	0.0	52.0	-526.690	78.0	-66.627	104.0	322.220	130.0	456.909	156.0	274.716	182.0	-643.051		

UPPERA VERSUS TIME LABELED B

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
0.0	0.0	26.0	-112.362	52.0	-498.867	78.0	-136.329	104.0	318.423	130.0	429.855	156.0	258.641	182.0	-503.612
2.0	0.0	28.0	-160.302	54.0	-510.702	80.0	-77.140	106.0	389.812	132.0	410.279	158.0	241.114	184.0	-499.789
4.0	0.0	30.0	-195.946	56.0	-477.569	82.0	-13.738	108.0	432.227	134.0	390.645	160.0	222.504	186.0	-425.596
6.0	0.0	32.0	-233.027	58.0	-497.668	84.0	25.454	110.0	503.383	136.0	403.124	162.0	184.186	188.0	-332.359
8.0	0.0	34.0	-283.355	60.0	-481.709	86.0	41.199	112.0	541.724	138.0	375.031	164.0	62.159	190.0	-209.910
10.0	0.0	36.0	-323.256	62.0	-454.514	88.0	69.470	114.0	570.133	140.0	371.355	166.0	-39.336	192.0	-94.222
12.0	0.0	38.0	-372.850	64.0	-414.792	90.0	73.866	116.0	577.382	142.0	329.271	168.0	-142.965	194.0	-9.514
14.0	0.0	40.0	-407.684	66.0	-395.069	92.0	58.249	118.0	597.273	144.0	325.348	170.0	-256.775	196.0	40.797
16.0	0.0	42.0	-427.378	68.0	-385.458	94.0	19.001	120.0	571.638	146.0	318.806	172.0	-410.928	198.0	82.789
18.0	0.0	44.0	-446.071	70.0	-361.660	96.0	-46.602	122.0	557.440	148.0	313.971	174.0	-555.602	200.0	124.310
20.0	0.0	46.0	-454.782	72.0	-314.963	98.0	-54.722	124.0	506.868	150.0	310.774	176.0	-552.188		
22.0	0.0	48.0	-468.987	74.0	-261.802	100.0	34.233	126.0	470.791	152.0	296.169	178.0	-510.157		
24.0	0.0	50.0	-483.772	76.0	-194.150	102.0	190.563	128.0	444.954	154.0	269.662	180.0	-502.009		
25.0	0.0	52.0	-498.867	78.0	-136.329	104.0	318.423	130.0	429.855	156.0	258.641	182.0	-503.612		

TABLE 13. SAMPLE INTERACTIVE AND AUXILIARY OUTPUT FOLLOWED BY BATCH OUTPUT (Page 11)

VALIDATION COMMAND LANGUAGE PROGRAM PAGE 8

CARTESIAN PLOT

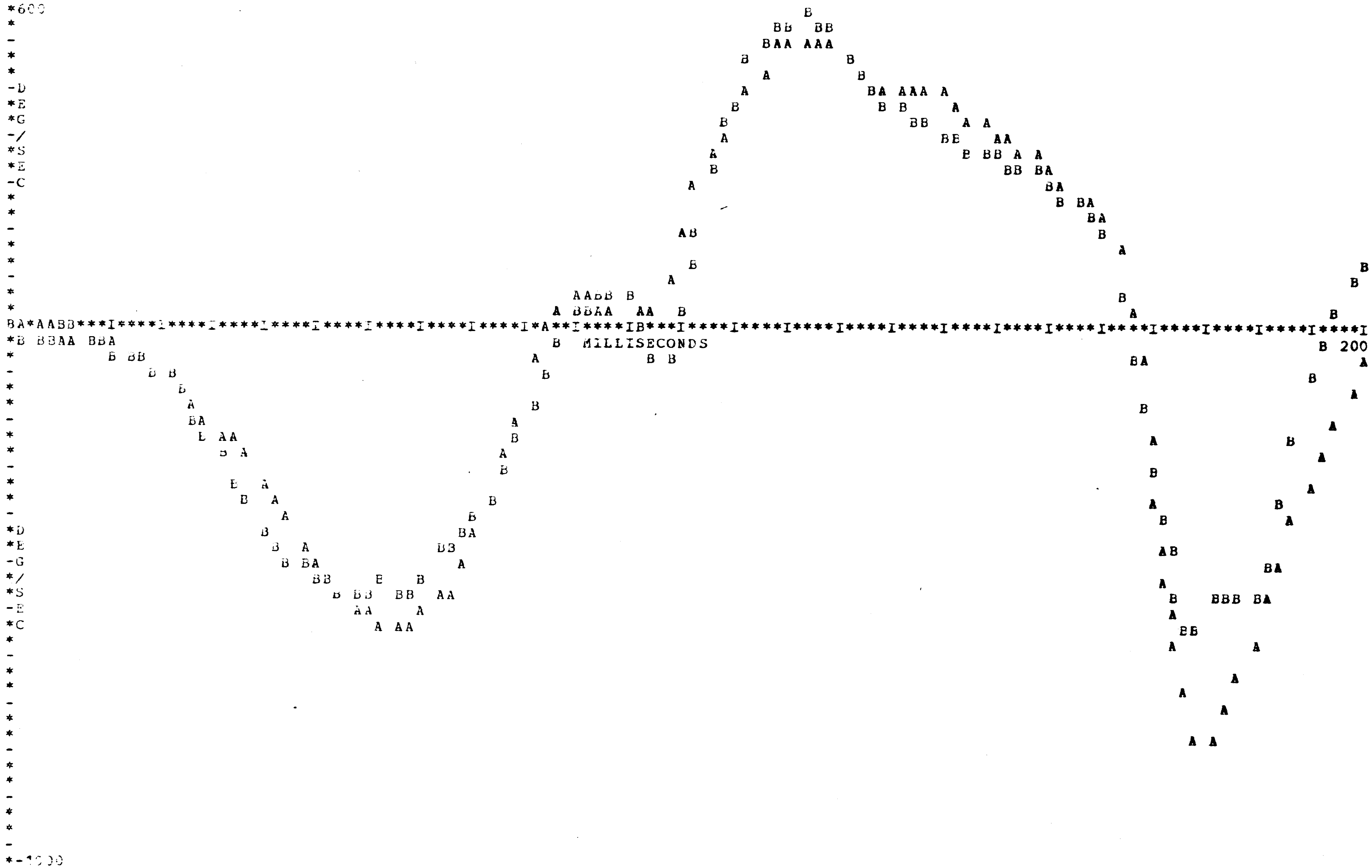

TABLE 13. SAMPLE INTERACTIVE AND AUXILIARY OUTPUT FOLLOWED BY BATCH OUTPUT (Page 12)

DEVIATION PLOT

DELTA MINUS DELTB VERSUS TIME LABELED A

TIME	FIRST	SECOND	DIFFERENCE	TIME	FIRST	SECOND	DIFFERENCE	TIME	FIRST	SECOND	DIFFERENCE	TIME	FIRST	SECOND	DIFFERENCE
0.0	0.0	0.0	0.0	52.0	4646.28	4582.94	63.34	104.0	12129.31	12880.50	-751.19	156.0	0.0	0.0	0.0
2.0	0.0	0.0	0.0	54.0	5282.78	5270.25	12.53	106.0	11462.69	12300.19	-837.50	158.0	0.0	0.0	0.0
4.0	0.0	0.0	0.0	56.0	5914.33	5956.58	-42.25	108.0	10652.56	11569.19	-916.63	160.0	0.0	0.0	0.0
6.0	0.0	0.0	0.0	58.0	6536.55	6635.29	-98.73	110.0	9688.88	10669.56	-980.69	162.0	0.0	0.0	0.0
8.0	0.0	0.0	0.0	60.0	7150.77	7304.29	-153.51	112.0	8560.00	9587.50	-1027.50	164.0	0.0	0.0	0.0
10.0	0.0	0.0	0.0	62.0	7751.35	7955.48	-204.13	114.0	7262.06	8319.81	-1057.75	166.0	0.0	0.0	0.0
12.0	0.0	0.0	0.0	64.0	8338.17	8585.73	-247.56	116.0	5801.31	6863.81	-1062.50	168.0	0.0	0.0	0.0
14.0	0.0	0.0	0.0	66.0	8910.52	9193.07	-282.55	118.0	4199.25	5233.31	-1034.06	170.0	0.0	0.0	0.0
16.0	0.0	0.0	0.0	68.0	9462.45	9774.02	-311.57	120.0	2485.38	3453.44	-968.06	172.0	0.0	0.0	0.0
18.0	0.0	0.0	0.0	70.0	9988.87	10323.78	-334.91	122.0	707.94	1558.56	-850.63	174.0	0.0	0.0	0.0
20.0	0.56	4.30	-3.74	72.0	10483.85	10834.86	-351.01	124.0	0.0	0.0	0.0	176.0	0.0	0.0	0.0
22.0	99.51	95.82	3.69	74.0	10946.73	11310.06	-363.33	126.0	0.0	0.0	0.0	178.0	0.0	0.0	0.0
24.0	211.66	196.76	14.90	76.0	11374.89	11750.09	-375.20	128.0	0.0	0.0	0.0	180.0	0.0	0.0	0.0
26.0	338.84	309.50	29.34	78.0	11765.16	12153.90	-388.75	130.0	0.0	0.0	0.0	182.0	0.0	0.0	0.0
28.0	482.29	435.56	46.73	80.0	12118.73	12520.76	-402.02	132.0	0.0	0.0	0.0	184.0	0.0	0.0	0.0
30.0	643.56	578.08	65.48	82.0	12433.90	12847.96	-414.06	134.0	0.0	0.0	0.0	186.0	1782.41	0.0	1782.41
32.0	822.60	738.57	84.04	84.0	12713.44	13140.43	-426.99	136.0	0.0	0.0	0.0	188.0	3538.49	0.0	3538.49
34.0	1019.13	917.97	101.16	86.0	12955.76	13398.34	-442.58	138.0	0.0	0.0	0.0	190.0	5050.34	0.0	5050.34
36.0	1229.57	1115.88	113.68	88.0	13155.44	13620.45	-465.01	140.0	0.0	0.0	0.0	192.0	6301.50	0.0	6301.50
38.0	1455.39	1335.12	120.27	90.0	13308.31	13799.84	-491.53	142.0	0.0	0.0	0.0	194.0	7315.42	0.0	7315.42
40.0	1694.51	1574.05	120.45	92.0	13410.57	13924.12	-513.55	144.0	0.0	0.0	0.0	196.0	8133.57	1222.51	6911.06
42.0	1944.67	1831.19	113.48	94.0	13460.37	13987.70	-527.33	146.0	0.0	0.0	0.0	198.0	8788.56	2870.74	5917.82
44.0	2210.63	2107.62	103.00	96.0	13443.06	13983.81	-540.75	148.0	0.0	0.0	0.0	200.0	9293.58	4336.22	4957.36
46.0	2730.04	2595.46	184.59	98.0	13320.00	13874.75	-554.75	150.0	0.0	0.0	0.0				
48.0	3389.06	3239.47	149.59	100.0	13065.00	13657.31	-592.31	152.0	0.0	0.0	0.0				
50.0	4012.94	3903.60	109.34	102.0	12664.19	13328.31	-664.13	154.0	0.0	0.0	0.0				
52.0	4646.28	4582.94	63.34	104.0	12129.31	12880.50	-751.19	156.0	0.0	0.0	0.0				

FCHAA MINUS FCHBB VERSUS TIME LABELED B

TIME	FIRST	SECOND	DIFFERENCE	TIME	FIRST	SECOND	DIFFERENCE	TIME	FIRST	SECOND	DIFFERENCE	TIME	FIRST	SECOND	DIFFERENCE
140.0	0.0	0.0	0.0	156.0	1029.23	650.34	378.89	172.0	8921.35	12860.25	-3938.90	188.0	818.32	1346.70	-528.37
142.0	69.02	0.0	69.02	158.0	1552.51	872.89	679.62	174.0	6538.60	12401.08	-5862.48	190.0	700.54	1208.36	-507.82
144.0	161.14	0.0	161.14	160.0	2505.35	1297.70	1207.64	176.0	3315.77	10041.89	-6726.12	192.0	594.12	1070.17	-476.05
146.0	254.67	86.73	167.93	162.0	4053.14	2113.02	1940.12	178.0	1480.82	6315.58	-4834.75	194.0	499.37	933.46	-434.09
148.0	357.91	182.47	175.43	164.0	6108.37	3590.20	2518.18	180.0	1352.24	1931.02	-578.78	196.0	415.41	798.89	-383.47
150.0	465.88	285.18	180.70	166.0	8273.25	5858.41	2414.84	182.0	1217.03	1748.97	-531.94	198.0	342.22	670.65	-328.44
152.0	583.62	396.75	186.87	168.0	9843.50	8683.49	1160.01	184.0	1080.38	1618.56	-538.18	200.0	280.75	553.37	-272.62
154.0	746.27	512.38	233.90	170.0	10109.15	11370.45	-1261.30	186.0	946.05	1483.70	-537.65				
156.0	1029.23	650.34	378.89	172.0	8921.35	12860.25	-3938.90	188.0	818.32	1346.70	-528.37				

TABLE 13. SAMPLE INTERACTIVE AND AUXILIARY OUTPUT FOLLOWED BY BATCH OUTPUT (Page 13)

VALIDATION COMMAND LANGUAGE PROGRAM PAGE 10

DEVIATION PLOT

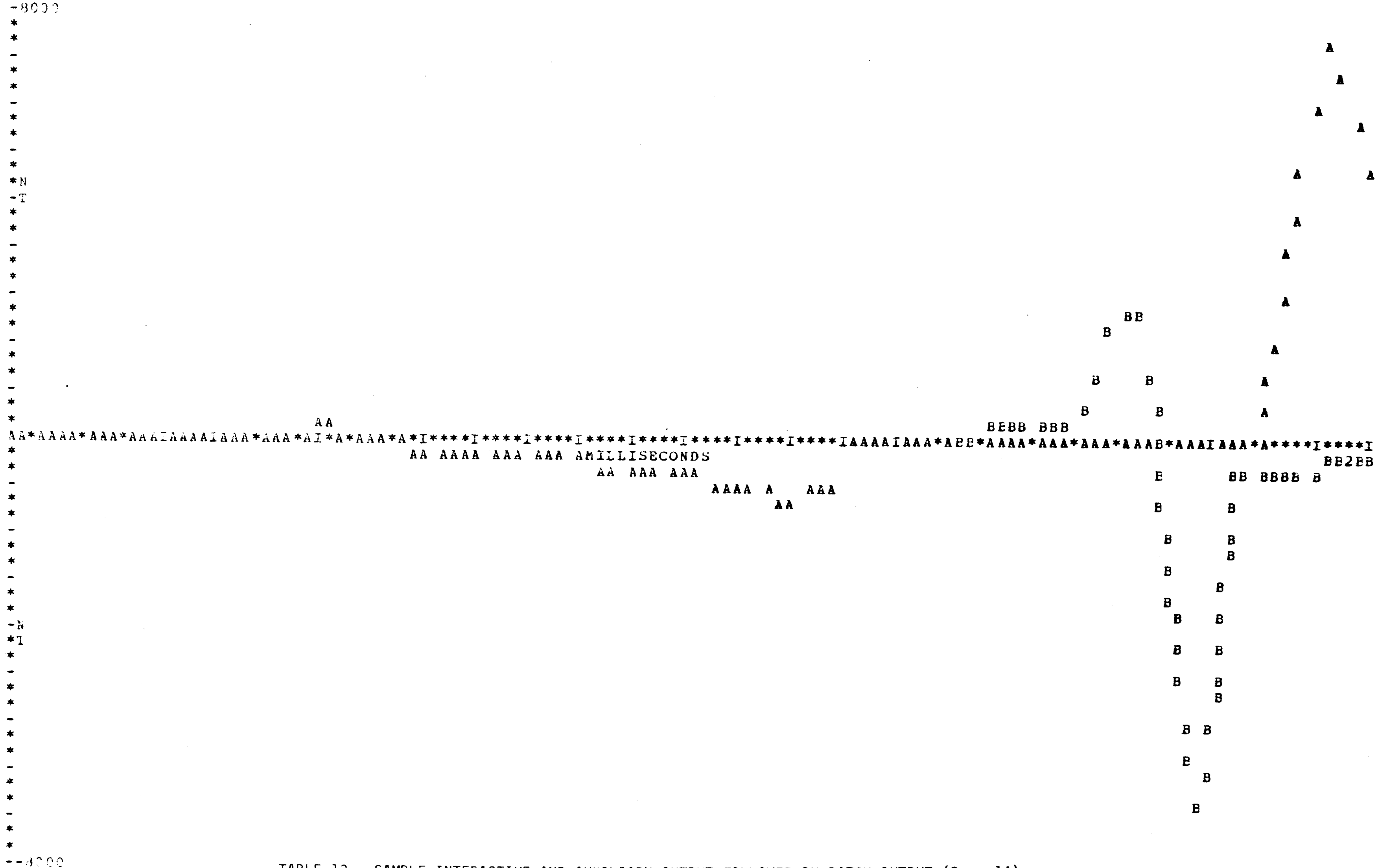

TABLE 13. SAMPLE INTERACTIVE AND AUXILIARY OUTPUT FOLLOWED BY BATCH OUTPUT (Page 14)

```
CP.
1,200.,1◆
TR NONE.
9◆
TQ TESTV.
1,10.,200.◆
MR.
1,2◆
MQ HEADA.
6,3,2.,200.◆
MR.
3,4◆
MQ HEADB.
6,3,2.,200.◆
TP HEADA.
0,10,200◆
TP HEADB.
0,10,200◆
SZ HEADA HEADC.
-100,10,200◆
TP HEADC.
0,10,100◆
SZ HEADA HEADD.
100,10,100◆
PS HEADD.
MC HEADA HEADB DIFF.
0,10,200◆
TP DIFF.
0,10,200◆
FI ANSW.
0,10,200◆
1.5◆$MHEADD+$QHEADA/$M$AHEADB◆2-DIFF-1$E
TP ANSW.
0,10,200◆
```

TABLE 14. INPUT FOLLOWED BY INTERACTIVE AND AUXILIARY OUTPUT FOR AN ADDITIONAL EXAMPLE (Page 1)

```
*$RUN OFF 5=NEWDAT 6=*PRINT* 7=*SINK* 8=FILTAB 9=TDAT 1=G9 2=G9 3=H8 4=H9
*EXECUTION BEGINS
 DEFAULT FINAL TIME IS RESET TO 200.0 MSEC
 OUTPUT QUANTITIES FOR THIS RUN ARE IN  METRIC  UNITS.
 LOGICAL DEVICE NUMBER FOR TEST DATA IS  9
 TEST QUANTITY NAMED TESTV    FROM    0.0 TO 200.0 AT  10.0 MSEC INTERVALS.
 NEXT FOUR LINES CONTAIN MODEL RUN DESCRIPTION
   MVMA 2-D MAN MODEL RUN A


                                                  MVMA 2-D, VER. 3
 JUL  8, 197600:04:29
 QUANTITIES FROM THIS RUN ARE IN  METRIC  UNITS.
 FINAL TIME RECORDED IS 200.0 MSEC TIME INCREMENT IS   2.0 MSEC
 ACTUAL NUMBER OF POINTS IS 101. NUMBER OF ELLIPSES = 15, OF LINES =  7
 OF REGIONS = 10, OF INTERACTIONS = 14
      UNFILTERED ACCELS                HEAD       RESULTNT
 MODEL QUANTITY NAMED  HEADA   FROM   0.0 TO 200.0 AT   2.0 MSEC INTERVALS.
 NEXT FOUR LINES CONTAIN MODEL RUN DESCRIPTION
   MVMA 2-D MAN MODEL RUN B


                                                  MVMA 2-D, VER. 3
 JUL  8, 197600:07:11
 QUANTITIES FROM THIS RUN ARE IN  METRIC  UNITS.
 FINAL TIME RECORDED IS 200.0 MSEC TIME INCREMENT IS   2.0 MSEC
 ACTUAL NUMBER OF POINTS IS 101. NUMBER OF ELLIPSES = 15, OF LINES =  6
 OF REGIONS =  9, OF INTERACTIONS = 14
      UNFILTERED ACCELS                HEAD       RESULTNT
 MODEL QUANTITY NAMED  HEADB   FROM   0.0 TO 200.0 AT   2.0 MSEC INTERVALS.
 FOR QUANTITY NAMED  HEADA   FROM   0.0 TO 200.0 AT  10.0 MSEC INTERVALS
 VALUES ARE              1.0007896        1.0137119        5.0835371
     9.5476389          11.387881        16.095520        21.485474
     31.805267          45.940032        56.449768        51.412781
     47.430054          34.800262        19.003983        7.7531462
     12.997203          26.256638        48.055664        65.814514
     28.172714          30.897049
 FOR QUANTITY NAMED  HEADB   FROM   0.0 TO 200.0 AT  10.0 MSEC INTERVALS
 VALUES ARE              1.0007887        1.1737194        1.7064142
     4.2808084          11.944047        18.687119        23.456772
     31.468033          42.452438        53.143311        53.038574
     51.696533          36.514008        19.753586        8.6016703
     14.156677          21.414383        39.425552        84.110992
     78.054214          29.813995
 START TIME SHIFTED FROM    0.0 TO 100.0 MSEC
 QUANTITY NAMED  HEADA   , STARTING TIME SHIFTED FROM    0.0 TO     0.0 MSEC
 RENAMED  HEADC
 FOR QUANTITY NAMED  HEADC   FROM   0.0 TO 100.0 AT  10.0 MSEC INTERVALS
 VALUES ARE              51.412781        47.430054        34.800262
     19.003983          7.7531462        12.997203        26.256638
     48.055664          65.814514        28.172714        30.897049
 START TIME SHIFTED FROM    0.0 TO 100.0 MSEC
 QUANTITY NAMED  HEADA   SELECTED AT TIME 100.0 MSEC AND RENAMED  HEADD
 QUANTITY NAMED  HEADD   HAS VALUE          51.412781
 QUANTITY NAMED  HEADA   MINUS QUANTITY NAMED  HEADB   RENAMED  DIFF
 FOR QUANTITY NAMED   DIFF   FROM   0.0 TO 200.0 AT  10.0 MSEC INTERVALS
 VALUES ARE             0.95367432E-06  -0.16000748        3.3771229
     5.2668304         -0.55616570      -2.5915985       -1.9712982
    0.33723450          3.4875946        3.3064575       -1.6257935
    -4.2664795         -1.7137451      -0.74960327      -0.84852409
    -1.1594744          4.8422546        8.6301117       -18.296478
    -49.881500          1.0830536
 RESULT OF FORMULA INTERPRETER IS        -80.12   -79.67   -84.14   -84.83
   -78.13   -75.96   -76.54   -78.81   -81.93   -81.71   -76.76   -74.12
   -76.73   -77.81   -77.92   -77.47   -83.44   -87.10   -60.02   -28.37
   -79.58
 FOR QUANTITY NAMED   ANSW   FROM   0.0 TO 200.0 AT  10.0 MSEC INTERVALS
 VALUES ARE             -80.118378       -79.674774       -84.138870
    -84.829605         -78.128067       -75.956940       -76.543076
    -78.814835         -81.926071       -81.708374       -76.763748
    -74.119125         -76.728531       -77.810928       -77.918060
    -77.469009         -83.439987       -87.100937       -60.015594
    -28.373672         -79.575104
```

TABLE 14. INPUT FOLLOWED BY INTERACTIVE AND AUXILIARY OUTPUT FOR AN ADDITIONAL EXAMPLE (Page 2)

```
CP.
1,200,1*
DEFAULT FINAL TIME IS RESET TO 200.0 MSEC
OUTPUT QUANTITIES FOR THIS RUN ARE IN  METRIC  UNITS.
MR.
1,2*
NEXT FOUR LINES CONTAIN MODEL RUN DESCRIPTION
  MVMA 2-D MAN MODEL RUN B


                                                  MVMA 2-D, VER. 3
JUL  8, 197600:07:11
QUANTITIES FROM THIS RUN ARE IN  METRIC  UNITS.
FINAL TIME RECORDED IS 200.0 MSEC TIME INCREMENT IS   2.0 MSEC
ACTUAL NUMBER OF POINTS IS 101. NUMBER OF ELLIPSES = 15, OF LINES =  6
OF REGIONS =  9, OF INTERACTIONS = 14
MQ HEADA.
6,3,2,200*
     UNFILTERED ACCELS             HEAD       RESULTNT
MODEL QUANTITY NAMED  HEADA   FROM   0.0 TO 200.0 AT   2.0 MSEC INTERVALS.
FG FILTA.

         FILTER DESIGN PROGRAM
         ---------------------

ENTER COMMAND: (DESIGN, GENERATE OR SAVE)
D

....... FILTER DESIGN ROUTINE .......

SAMPLING RATE? (HZ)
800.

HOW MANY BANDS?
    2

BAND # 1: 0.0        = LF < UF <  400.00       ENTER
FREQ. OF UPPER EDGE , RIPPLE(GAIN)  ,
40.,.025

BAND # 2:  40.000     < LF < UF =  400.00       ENTER
LOWER EDGE, RIPPLE(GAIN)
80.,-50.

ENTER THE NUMBER OF THE BAND WITH WEIGHT=1
 1

FILTER MAGNITUDE RESPONSE SPECS:
BAND     LOWER          UPPER        GAIN        WEIGHT
  1   0.0           40.000       1.0000        1.0000
  2   80.000        400.00       0.0           0.91137
IS THIS ACCEPTABLE?
Y

FILTER LENGTH? (3<...<128)
   56

DO YOU WISH TO OPTIMIZE?
N
GRID DENSITY?
  100
```

TABLE 15. SAMPLE INTERACTIVE SESSION WITH THE FILTER DESIGN COMMAND (Page 1)

```
....... FILTER CHARACTERISTICS .......

FINITE IMPULSE RESPONSE (FIR)
BANDPASS FILTER
    FILTER LENGTH   =  56
    GRID DENSITY   = 36
    NO. ITERATIONS =   7
    TOTAL DEVIATION=   0.025459293 DB

                         BAND  1          BAND  2          BAND
 LOWER EDGE(HZ)     0.0               80.0000
 UPPER EDGE(HZ)      40.0000          400.000
 DESIRED VALUE       1.00000         0.0
 WEIGHTING           1.00000         0.911368
 DEVIATION          0.254593E-01    -49.8390
 DESIRED DEVIATION    0.249968E-01    -50.0000

OUTPUT EXTREMAL FREQ.S ?
Y

 EXTREMAL FREQUENCIES
    0.0          0.0173611    0.0332340    0.0451387    0.0500000
    0.1000000    0.1049603    0.1163689  . 0.1317459    0.1481149
    0.1654759    0.1833330    0.2006940    0.2190471    0.2369042
    0.2547613    0.2731144    0.2909715    0.3093246    0.3276777
    0.3455347    0.3638878    0.3817449    0.4000980    0.4184511
    0.4363082    0.4546613    0.4725184    0.4908715

OUTPUT GRAPH OF FILTER?
Y

SAMPLING FREQ?
800.
LOG SCALE?
Y

BEG,END,POINTS?
20.,200.,36.
```

FIGURE 15. SAMPLE INTERACTIVE SESSION WITH THE FILTER DESIGN COMMAND (Page 2)

```
   20.000     0.00 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   21.360    -0.01 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   22.813    -0.01 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   24.364    -0.02 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   26.021    -0.03 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   27.790    -0.02 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   29.680    -0.02 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   31.698    -0.00 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   33.853     0.02 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   36.155     0.03 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   38.614     0.01 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   41.240    -0.07 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   44.044    -0.27 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   47.039    -0.65 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   50.238    -1.32 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   53.654    -2.42 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   57.302    -4.12 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   61.199    -6.69 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   65.361   -10.53 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   69.805   -16.32 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   74.552   -25.63 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   79.621   -46.33 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   85.036   -51.00 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   90.818   -52.09 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   96.994   -55.78 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
  103.589   -50.60 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
  110.634   -61.05 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
  118.157   -49.87 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
  126.191   -64.85 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
  134.772   -51.18 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
  143.937   -51.29 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
  153.725   -80.45 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
  164.178   -52.58 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
  175.342   -49.85 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
  187.266   -50.91 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
  200.000   -53.55 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
LOG SCALE?
N

BEG,END,POINTS?
30,100,15.
   30.000    -0.01 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   35.000     0.02 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   40.000    -0.03 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   45.000    -0.37 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   50.000    -1.26 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   55.000    -2.97 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   60.000    -5.81 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   65.000   -10.14 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   70.000   -16.62 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   75.000   -26.78 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   80.000   -49.83 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   85.000   -50.94 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   90.000   -54.38 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
   95.000   -50.99 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
  100.000   -61.26 ◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆
LOG SCALE?

BEG,END,POINTS?

WANT TO TRY FOR BETTER RESULTS?
N

OUTPUT IMPULSE RESPONSE?
Y
```

TABLE 15. SAMPLE INTERACTIVE SESSION WITH THE FILTER DESIGN COMMAND (Page 3)

```
....... IMPULSE RESPONSE .......

 H(  1) =  0.15949821E-02 = H( 56)
 H(  2) = -0.28400123E-03 = H( 55)
 H(  3) = -0.99320004E-03 = H( 54)
 H(  4) = -0.19484404E-02 = H( 53)
 H(  5) = -0.28643170E-02 = H( 52)
 H(  6) = -0.33265790E-02 = H( 51)
 H(  7) = -0.29421812E-02 = H( 50)
 H(  8) = -0.14629057E-02 = H( 49)
 H(  9) =  0.10841349E-02 = H( 48)
 H( 10) =  0.43138936E-02 = H( 47)
 H( 11) =  0.74882284E-02 = H( 46)
 H( 12) =  0.96332692E-02 = H( 45)
 H( 13) =  0.97594336E-02 = H( 44)
 H( 14) =  0.71469322E-02 = H( 43)
 H( 15) =  0.16312907E-02 = H( 42)
 H( 16) = -0.61906800E-02 = H( 41)
 H( 17) = -0.14906716E-01 = H( 40)
 H( 18) = -0.22427037E-01 = H( 39)
 H( 19) = -0.26321217E-01 = H( 38)
 H( 20) = -0.24295449E-01 = H( 37)
 H( 21) = -0.14725301E-01 = H( 36)
 H( 22) =  0.28865766E-02 = H( 35)
 H( 23) =  0.27626306E-01 = H( 34)
 H( 24) =  0.57162046E-01 = H( 33)
 H( 25) =  0.88024139E-01 = H( 32)
 H( 26) =  0.11614633     = H( 31)
 H( 27) =  0.13756704     = H( 30)
 H( 28) =  0.14914519     = H( 29)

ENTER COMMAND: (DESIGN, GENERATE OR SAVE)
G

.........PULSE GENERATION ROUTINE......

SIGNAL HAS FIVE SINE-WAVE COMPONENTS:
ENTER HIGHEST DESIRED FREQUENCY:   (HZ)
800.

COMPONENT FREQUENCIES ARE:
1 AT      4.00 HZ
2 AT     40.00 HZ
3 AT    160.00 HZ
4 AT    400.00 HZ
5 AT    800.00 HZ


ARE THEY ACCEPTABLE?
N

HOW MANY COMPONENTS ARE DESIRED?
5,
COMPONENT # 1:   WHAT FREQ.  (HZ)?
1.
COMPONENT # 2:   WHAT FREQ.  (HZ)?
20.
COMPONENT # 3:   WHAT FREQ.  (HZ)?
35.
COMPONENT # 4:   WHAT FREQ.  (HZ)?
55.
COMPONENT # 5:   WHAT FREQ.  (HZ)?
200.
```

TABLE 15. SAMPLE INTERACTIVE SESSION WITH THE FILTER DESIGN COMMAND (Page 4)

```
MINIMUM SAMPLING AT     400.0 HZ
ENTER DESIRED RATE (HZ):
800.

LONGEST PERIOD =  1000.000 MSEC.
ENTER DESIRED SIGNAL DURATION (MSEC)
400.

COMPOSIT SIGNAL ( 321 PTS) GENERATED FROM

1 AT      1.00 HZ
2 AT     20.00 HZ
3 AT     35.00 HZ
4 AT     85.00 HZ
5 AT    200.00 HZ


....... FILTERING OF SIGNAL .......

NOTICE:
------
COMPONENTS HAVE FOLLOWING FREQUENCIES:

IN (HERTZ):          1.00       20.00       35.00       85.00      200.00
NORMALIZED:      0.00125     0.02500     0.04375     0.10625     0.25000
WITH SAMPLING AT    800.00 HZ.

IS THE      1.00 HZ COMPONENT INTENDED TO BE FILTERED OUT?
N
IS THE     20.00 HZ COMPONENT INTENDED TO BE FILTERED OUT?
N
IS THE     35.00 HZ COMPONENT INTENDED TO BE FILTERED OUT?
N
IS THE     85.00 HZ COMPONENT INTENDED TO BE FILTERED OUT?
Y
IS THE    200.00 HZ COMPONENT INTENDED TO BE FILTERED OUT?
Y

SIGNAL (NPTS= 321)   HAS BEEN FILTERED.

ENTER  NBEG,NEND,NSKP  FOR OUTPUT,    OR RETURN TO EXIT:
1,321,5,

ENTER  NBEG,NEND,NSKP  FOR OUTPUT,    OR RETURN TO EXIT:


ENTER COMMAND: (DESIGN, GENERATE OR SAVE)
S

FILTER  FILTA    HAS BEEN ENTERED
FD HEADA HFILA FILTA.
FILTER NAMED  FILTA    WITH 56 WEIGHTS, 2 BANDS
YOUR SAMPLING FREQUENCY IS  500.0000 HZ.
FROM     0.0 TO    25.0 WITH A GAIN OF 1.0000
FROM    50.0 TO   250.0 WITH A GAIN OF 0.0
IS THIS ACCEPTABLE? ANSWER YES OR NO.
Y
```

TABLE 15. SAMPLE INTERACTIVE SESSION WITH THE FILTER DESIGN COMMAND (Page 5)

```
IMPULSE RESPONSE IS  0.159498E-02 -0.284001E-03 -0.983200E-03 -0.194844E-02
 -0.286432E-02 -0.332658E-02 -0.294218E-02 -0.146291E-02  0.108413E-02
  0.431389E-02  0.748823E-02  0.963327E-02  0.975943E-02  0.714693E-02
  0.163129E-02 -0.619068E-02 -0.149067E-01 -0.224270E-01 -0.263212E-01
 -0.242954E-01 -0.147253E-01  0.288658E-02  0.276263E-01  0.571620E-01
  0.880241E-01  0.116146E+00  0.137567E+00  0.149145E+00  0.149145E+00
  0.137567E+00  0.116146E+00  0.880241E-01  0.571620E-01  0.276263E-01
  0.288658E-02 -0.147253E-01 -0.242954E-01 -0.263212E-01 -0.224270E-01
 -0.149067E-01 -0.619068E-02  0.163129E-02  0.714693E-02  0.975943E-02
  0.963327E-02  0.748823E-02  0.431389E-02  0.108413E-02 -0.146291E-02
 -0.294218E-02 -0.332658E-02 -0.286432E-02 -0.194844E-02 -0.983200E-03
 -0.284001E-03  0.159498E-02
QUANTITY NAMED  HEADA    FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS
HAS BEEN FILTERED BY  FILTA    AND RENAMED  HFILA
FD HEBBB HFILB LP050000.
FILTER NAMED LP050000 WITH 56 WEIGHTS, 2 BANDS
YOUR SAMPLING FREQUENCY IS  500.0000 HZ.
FROM     0.0 TO    25.0 WITH A GAIN OF 1.0000
FROM    50.0 TO   250.0 WITH A GAIN OF 0.0
IS THIS ACCEPTABLE? ANSWER YES OR NO.
Y
IMPULSE RESPONSE IS  0.159496E-02 -0.283998E-03 -0.983199E-03 -0.194845E-02
 -0.286433E-02 -0.332659E-02 -0.294219E-02 -0.146290E-02  0.108415E-02
  0.431391E-02  0.748825E-02  0.963328E-02  0.975944E-02  0.714692E-02
  0.163128E-02 -0.619070E-02 -0.149067E-01 -0.224271E-01 -0.263212E-01
 -0.242954E-01 -0.147253E-01  0.288660E-02  0.276263E-01  0.571621E-01
  0.880242E-01  0.116146E+00  0.137567E+00  0.149145E+00  0.149145E+00
  0.137567E+00  0.116146E+00  0.880242E-01  0.571621E-01  0.276263E-01
  0.288660E-02 -0.147253E-01 -0.242954E-01 -0.263212E-01 -0.224271E-01
 -0.149067E-01 -0.619070E-02  0.163128E-02  0.714692E-02  0.975944E-02
  0.963328E-02  0.748825E-02  0.431391E-02  0.108415E-02 -0.146290E-02
 -0.294219E-02 -0.332659E-02 -0.286433E-02 -0.194845E-02 -0.983199E-03
 -0.283998E-03  0.159496E-02
QUANTITY NAMED\ HEADA    FROM    0.0 TO 200.0 AT    2.0 MSEC INTERVALS
HAS BEEN FILTERED BY LP050000 AND RENAMED  HFILB
TP HEADA.
0,10,200*
FOR QUANTITY NAMED  HEADA    FROM    0.0 TO 200.0 AT   10.0 MSEC INTERVALS
VALUES ARE           1.0007887        1.1737194        1.7064142
    4.2808034       11.944047        18.687119        23.456772
    31.468032       42.452438        53.143311        53.038574
    51.696533       36.514008        19.753586        8.6016703
    14.156677       21.414383        39.425552        84.110992
    78.054214       29.813995
TP HFILA.
0,10,200*
FOR QUANTITY NAMED  HFILA    FROM    0.0 TO 200.0 AT   10.0 MSEC INTERVALS
VALUES ARE           0.13823748       1.3250761        1.5056028
    4.4124880       11.531440        18.810303        23.044861
    30.304077       44.780914        54.179306        53.384171
    49.609375       37.557205        18.144989        9.5435743
    11.960663       20.442841        48.966583        81.714615
    70.640778       4.1181870
TP HFILB.
0,10,200*
FOR QUANTITY NAMED  HFILB    FROM    0.0 TO 200.0 AT   10.0 MSEC INTERVALS
VALUES ARE           0.13823688       1.3250732        1.5056000
    4.4124765       11.531422        18.810257        23.044815
    30.304001       44.780838        54.179230        53.384079
    49.609329       37.557129        18.144943        9.5435591
    11.960642       20.442795        48.966537        81.714493
    70.640610       4.1181803
```

TABLE 15. SAMPLE INTERACTIVE SESSION WITH THE FILTER DESIGN COMMAND
(Page 6)

```
MC HFILA HFILB BIFFA.
0,10,200*
QUANTITY NAMED  HFILA   MINUS QUANTITY NAMED  HFILB   RENAMED  DIFFA
TP DIFFA.
0,10,200*
FOR QUANTITY NAMED  DIFFA   FROM   0.0 TO 200.0 AT  10.0 MSEC INTERVALS
VALUES ARE          0.59604645E-06   0.28610229E-05   0.28610229E-05
   0.11444092E-04   0.18119812E-04   0.45776367E-04   0.45776367E-04
   0.76293945E-04   0.76293945E-04   0.76293945E-04   0.91552734E-04
   0.45776367E-04   0.76293945E-04   0.45776367E-04   0.15258789E-04
   0.20980835E-04   0.45776367E-04   0.45776367E-04   0.12207031E-03
   0.16784668E-03   0.66757202E-05
MC HEADA HFILA DIFFB.
0,10,200*
QUANTITY NAMED  HEADA   MINUS QUANTITY NAMED  HFILA   RENAMED  DIFFB
TP DIFFB.
0,10,200*
FOR QUANTITY NAMED  DIFFB   FROM   0.0 TO 200.0 AT  10.0 MSEC INTERVALS
VALUES ARE     \    0.86255121      -0.15135670       0.20081139
  -0.13167953       0.41260719      -0.12318420       0.41191101
    1.1639557      -2.3284760       -1.0359955       -0.34559631
    2.0871582      -1.0431976        1.6085968       -0.94190407
    2.1960144       0.97154236      -9.5410309        2.3963776
    7.4134369       25.695801
```

TABLE 15. SAMPLE INTERACTIVE SESSION WITH FILTER DESIGN COMMAND (Page 7)

******** CHECK OF FILTERING ROUTINE

N	UNFILTERED SIGNAL	FILTERED SIGNAL	SHOULD BE
1	0.0	0.000001	0.0
6	2.532063	1.732441	1.727151
11	1.843836	1.463224	1.461144
16	-1.562387	-0.011502	-0.006822
21	0.156395	-0.555279	-0.550673
26	0.212089	0.044981	0.043551
31	1.081247	0.160329	0.157327
36	-2.611533	-0.633719	-0.630753
41	0.308961	-0.698011	-0.690988
46	0.877330	0.855479	0.858120
51	3.230515	2.309749	2.306559
56	-0.150139	1.682221	1.681349
61	0.453941	-0.259412	-0.253099
66	-0.605557	-1.057489	-1.049963
71	0.287978	-0.096337	-0.094838
76	-0.365885	0.830843	0.829245
81	0.587735	0.584434	0.587805
86	1.540465	0.337094	0.345412
91	0.884218	1.261522	1.266744
96	1.772895	2.218211	2.217366
101	0.707031	1.413896	1.414245
106	1.303120	-0.535801	-0.528324
111	-2.087190	-1.173214	-1.163482
116	0.254025	0.269417	0.273251
121	0.808841	1.809601	1.808993
126	3.714470	1.730317	1.733675
131	0.005040	0.919553	0.928773
136	0.855520	1.016470	1.024015
141	0.890791	1.596712	1.598122
146	2.588166	1.031344	1.032546
151	-0.841315	-0.466603	-0.458771
156	-1.554561	-0.760626	-0.749723
161	0.950726	0.945553	0.950993
166	3.455292	2.650325	2.650314
171	2.737917	2.352034	2.355084
176	-0.699035	0.846836	0.856468
181	0.987215	0.271221	0.280578
186	1.010090	0.838380	0.841517
191	1.845037	0.919445	0.920816
196	-1.883715	0.089929	0.097053
201	0.999637	-0.011003	-0.000033
206	1.530383	1.504789	1.511186
211	3.844975	2.920467	2.920776
216	0.424277	2.253406	2.255801
221	0.987334	0.271280	0.280651
226	-0.113442	-0.568155	-0.557794
231	0.738223	0.350932	0.355008
236	0.040926	1.235370	1.236119
241	0.950783	0.945626	0.951083
246	1.659494	0.654351	0.664503
251	1.158916	1.534360	1.541150
256	2.002189	2.446259	2.446712
261	0.890605	1.596799	1.598190

TABLE 15. SAMPLE INTERACTIVE SESSION WITH FILTER DESIGN COMMAND (Page 8)

```
 266        1.441297       -0.398381       -0.390112
 271       -1.994592       -1.081507       -1.071262
 276        0.300124        0.315174        0.319363
 281        0.808513        1.809588        1.808974
 286        3.668358        1.685326        1.687551
 291       -0.086958        0.824296        0.836551
 296        0.717376        0.885561        0.885836
 301        0.706417        1.430806        1.414225
 306        2.358908        0.770465        0.803236
 311       -1.115406       -0.708669       -0.733175
 316       -1.873614       -1.014369       -1.068838
 321        0.587021        0.081084        0.587675
FREQUENCIES NORMALIZED TO SAMPLING OF      800.00 HZ.
 2 BANDS:   # 1     # 2     #
    FROM: 0.0     0.1000
      TO: 0.0500 0.5000
    GAIN: 1.0000 0.0
 56=LENGTH OF FILTER.   BELOW IS ITS IMPULSE RESPONSE
  0.159498E-02-0.284001E-03-0.983200E-03-0.194844E-02-0.286432E-02-0.332658E-02
 -0.294218E-02-0.146291E-02 0.108413E-02 0.431389E-02 0.748823E-02 0.963327E-02
  0.975943E-02 0.714693E-02 0.163129E-02-0.619068E-02-0.149067E-01-0.224270E-01
 -0.263212E-01-0.242954E-01-0.147253E-01 0.288658E-02 0.276263E-01 0.571620E-01
  0.880241E-01 0.116146E+00 0.137567E+00 0.149145E+00 0.149145E+00 0.137567E+00
  0.116146E+00 0.880241E-01 0.571620E-01 0.276263E-01 0.288658E-02-0.147253E-01
 -0.242954E-01-0.263212E-01-0.224270E-01-0.149067E-01-0.619068E-02 0.163129E-02
  0.714693E-02 0.975943E-02 0.963327E-02 0.748823E-02 0.431389E-02 0.108413E-02
 -0.146291E-02-0.294218E-02-0.332658E-02-0.286432E-02-0.194844E-02-0.983200E-03
 -0.284001E-03 0.159498E-02
0
0
0
0
0
0
0
0
0
0
0
0
STOP
```

TABLE 15. SAMPLE INTERACTIVE SESSION WITH FILTER DESIGN COMMAND (Page 9)

```
CP.
1,200.,1*
TR NONE.
9*
TO TESTV.
1,10.,200.*
MR.
1,2*
MQ HEADA.
6,3,5.,200.*
MQ CHESTA.
6,6,5.,200.*
MQ HIPA.
6,9,5.,200.*
MQ FCHA UPPER TORSO       SBU
4,3,5.,200.*
MQ BELTA UPPER TORSO BELT
4,25,5.,200.*
MQ LOWERA.
11,4,5.,200.*
MQ UPPERA.
11,3,5.,200.*
RF TESTV.
0.,10.,200.,2,10,2,2*
FG FILTA.
D
800.
     2
40.                .03
80.                -40.
 1
Y
    30
N
  100
Y
Y
800.
Y
20.         200.        36.
N
30.         100.        15.
N
Y
G
800.
N
     5
1.
20.
35.
85.
200.
800.
400.
N
N
N
```

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 1)

```
Y
Y
     1  321     5

S
FD HEADA HFILA FILTA.
Y
TP HEADA.
0,10,200*
TP HFILA.
0,10,200*
MC HEADA HFILA HFILC.
0,10,200*
TP HFILC.
0,10,200*
OM TESTV.
QP HEADA CHESTA.
100.,10.,150.,5.,100.,10.,150.,5.,10*
QA HEADA CHESTA.
140.,5.,140.,5.,20,.8,.1,1.2*
FC HEADA.
0.,5.,200.,5*
SZ FCHA FCHAA.
140.,5.,200.*
CH HEADA HICA.
5,5,.85*
CS CHESTA SIA.
0.,5.,200.*
CG CHESTA MSIA.
0.,5.,200.*
CM HIPA.
0.,200.*
CI FCHAA FCHAAI.
140.,200.*
CF HEADA.
50.,5.,150.,4*
TM HEADA.
0.,5.,200.*
MA TESTV TESTV2.
2.,0.,10.,200.*
CC CHESTA HIPA CCC.
0.,5.,200.,0.,5.*
CV HIPA CHESTA.
PM LOWERA UPPERA  VFL.
0.,5.,200.*
SZ HEADA HEADC.
-100,10,200*
TP HEADC.
0,10,100*
SZ HEADA HEADD.
100,10,100*
PS HEADD.
MC HEADA CHESTA DIFF.
0,10,200*
TP DIFF.
0,10,200*
FI ANSW.
0,10,200*
1.5*$MHEADD+$QHEADA/$M$AHFILC*2-DIFF-1$E
TP ANSW.
```

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 2)

```
0,10,200*
SP PRINT POLAR.
.2,.2,.2*
PQ HICA SIA.
10.*
PQ SIA HEADAPK.
46.*
PQ MSIA HEADD.
82.*
PQ HIPAEN HIPAAX.
118.*
PQ FCHAAI SIA.
154.*
PQ HEADAPK HEADD.
262.*
PQ HEADAAV HEADAPK.
298.*
PQ VELAX VELEN.
334.*
PP.
SP PRINT PHASE.
100.,0.,0.,15000.*
PC FCHA CHESTA.
PP.
SP PRINT CART.
200.,-1000.,600.*
PC VEL.
PC UPPERA.
PP.
SP PRINT DEV.
200.,-8000.,8000.*
PC BELTA HEADA.
PC CHESTA HEADA.
PP.
PS CCC.
END OF FILE
```

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 3)

```
DEFAULT FINAL TIME IS RESET TO 200.0 MSEC
OUTPUT QUANTITIES FOR THIS RUN ARE IN  METRIC  UNITS.
LOGICAL DEVICE NUMBER FOR TEST DATA IS  9
TEST QUANTITY NAMED TESTV   FROM    0.0 TO 200.0 AT  10.0 MSEC INTERVALS.
NEXT FOUR LINES CONTAIN MODEL RUN DESCRIPTION
      IIHS BASELINE. 50TH MALE. LOOSE NECK.  APPROX. OLD 20 NO.316
50M. LOOSE NECK.      50M ST.BACK          ST. BACK SEAT        SEAT AND FLOOR
REAR 30 MPH           LAP BELT              MVMA 2-D, VER. 3
OCT 28, 197623:09:47
QUANTITIES FROM THIS RUN ARE IN  METRIC  UNITS.
FINAL TIME RECORDED IS 200.0 MSEC TIME INCREMENT IS   5.0 MSEC
ACTUAL NUMBER OF POINTS IS  41. NUMBER OF ELLIPSES =  7. OF LINES =  4
OF REGIONS =  5, OF INTERACTIONS =  8
     UNFILTERED ACCELS               HEAD       RESULTNT
MODEL QUANTITY NAMED  HEADA   FROM   0.0 TO 200.0 AT    5.0 MSEC INTERVALS.
     UNFILTERED ACCELS               CHEST      RESULTNT
MODEL QUANTITY NAMED  CHESTA  FROM   0.0 TO 200.0 AT    5.0 MSEC INTERVALS.
     UNFILTERED ACCELS               HIP        RESULTNT
MODEL QUANTITY NAMED   HIPA   FROM   0.0 TO 200.0 AT    5.0 MSEC INTERVALS.
ELL-LIN:UPPER TORSO       VS SBU                NM FORCE
MODEL QUANTITY NAMED   FCHA   FROM   0.0 TO 200.0 AT    5.0 MSEC INTERVALS.

VARIABLE SPECIFICATION ILLEGAL OR VARIABLE ABSENT---CATG.NO.=  4 COL.NO.= 25
IDENTIFIERS=UPPER TORSO BELT

MODEL QUANTITY NAMED  BELTA   FROM   0.0 TO 200.0 AT    5.0 MSEC INTERVALS.
     BODY LINK ANG VEL               MIDDLE     TORSO
MODEL QUANTITY NAMED  LOWERA  FROM   0.0 TO 200.0 AT    5.0 MSEC INTERVALS.
     BODY LINK ANG VEL               UPPER      TORSO
MODEL QUANTITY NAMED  UPPERA  FROM   0.0 TO 200.0 AT    5.0 MSEC INTERVALS.
```

I	X	Y	DEGREE 2 FIT	DEGREE 3 FIT
1	0.0	5.00	1.75	5.70
2	0.01	4.00	2.08	3.66
3	0.02	3.00	2.40	2.24
4	0.03	2.00	2.73	1.37
5	0.04	1.00	3.05	0.99
6	0.05	0.0	3.38	1.02
7	0.06	1.00	3.70	1.40
8	0.07	2.00	4.03	2.06
9	0.08	3.00	4.35	2.92
10	0.09	4.00	4.68	3.93
11	0.10	5.00	5.00	5.00
12	0.11	6.00	5.32	6.07
13	0.12	7.00	5.65	7.08
14	0.13	8.00	5.97	7.94
15	0.14	9.00	6.30	8.60
16	0.15	10.00	6.62	8.98
17	0.16	9.00	6.95	9.01
18	0.17	8.00	7.27	8.63
19	0.18	7.00	7.60	7.76
20	0.19	6.00	7.92	6.34
21	0.20	5.00	8.25	4.30

I	DEGREE 4 FIT	DEGREE 5 FIT	DEGREE 6 FIT	DEGREE 7 FIT
1	5.69	5.26	5.21	5.22
2	3.66	3.90	3.86	3.86
3	2.24	2.65	2.67	2.66
4	1.38	1.67	1.75	1.74

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 4)

5	0.99	1.06	1.15	1.15
6	1.02	0.87	0.93	0.94
7	1.40	1.10	1.11	1.12
8	2.06	1.71	1.66	1.67
9	2.92	2.63	2.53	2.54
10	3.92	3.77	3.66	3.66
11	4.99	5.02	4.93	4.93
12	6.07	6.27	6.23	6.22
13	7.07	7.40	7.43	7.42
14	7.94	8.30	8.39	8.39
15	8.60	8.89	9.02	9.02
16	8.98	9.10	9.22	9.22
17	9.02	8.90	8.94	8.95
18	8.64	8.29	8.22	8.23
19	7.77	7.32	7.16	7.15
20	6.34	6.10	5.96	5.95
21	4.29	4.80	4.97	4.97

I	DEGREE 8 FIT	DEGREE 9 FIT	DEGREE 10 FIT	DEGREE
1	5.19	5.31	5.26	
2	3.89	3.81	3.81	
3	2.69	2.57	2.62	
4	1.74	1.67	1.73	
5	1.13	1.14	1.18	
6	0.92	0.99	0.98	
7	1.11	1.21	1.15	
8	1.67	1.76	1.68	
9	2.55	2.59	2.53	
10	3.67	3.65	3.63	
11	4.93	4.86	4.89	
12	6.22	6.12	6.19	
13	7.41	7.32	7.40	
14	8.38	8.34	8.40	
15	9.02	9.06	9.05	
16	9.23	9.33	9.25	
17	8.97	9.03	8.98	
18	8.24	8.28	8.23	
19	7.16	7.07	7.13	
20	5.95	5.78	5.91	
21	5.01	5.09	5.00	

```
          FILTER DESIGN PROGRAM
          ---------------------

ENTER COMMAND: (DESIGN, GENERATE OR SAVE)

....... FILTER DESIGN ROUTINE .......

SAMPLING RATE? (HZ)

HOW MANY BANDS?

BAND # 1: 0.0          = LF < UF <  400.00        ENTER
FREQ. OF UPPER EDGE , RIPPLE(GAIN)

BAND # 2:  40.000     < LF < UF =  400.00        ENTER
LOWER EDGE, RIPPLE(GAIN)

ENTER THE NUMBER OF THE BAND WITH WEIGHT=1
```

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 5)

```
FILTER MAGNITUDE RESPONSE SPECS:
BAND      LOWER              UPPER          GAIN           WEIGHT
  1   0.0                 40.000          1.0000           1.0000
  2     80.000            400.00        0.0              0.34599
IS THIS ACCEPTABLE?

FILTER LENGTH? (3<...<128)

DO YOU WISH TO OPTIMIZE?
GRID DENSITY?

....... FILTER CHARACTERISTICS .......

FINITE IMPULSE RESPONSE (FIR)
BANDPASS FILTER
    FILTER LENGTH   =  30
    GRID DENSITY   = 66
    NO. ITERATIONS =  7
    TOTAL DEVIATION=    0.131151557 DB
                           BAND  1            BAND  2          BAND
 LOWER EDGE(HZ)      0.0                  80.0000
 UPPER EDGE(HZ)        40.0000             400.000
 DESIRED VALUE         1.00000          0.0
 WEIGHTING             1.00000          0.345993
 DEVIATION           0.131152           -27.1361
 DESIRED DEVIATION     0.300007E-01     -40.0000

OUTPUT EXTREMAL FREQ.S ?
 EXTREMAL FREQUENCIES
    0.0            0.0383837    0.0500000    0.1000000    0.1141408
    0.1424225      0.1752495    0.2085814    0.2424185    0.2767605
    0.3111026      0.3454446    0.3797867    0.4141287    0.4484708
    0.4828128

OUTPUT GRAPH OF FILTER?

SAMPLING FREQ?
LOG SCALE?

BEG,END,POINTS?
   20.000     0.01 **************************************************
   21.360     0.03 **************************************************
   22.813     0.05 **************************************************
   24.364     0.08 **************************************************
   26.021     0.10 **************************************************
   27.790     0.12 **************************************************
   29.680     0.13 **************************************************
   31.698     0.13 **************************************************
   33.853     0.11 **************************************************
   36.155     0.05 **************************************************
   38.614    -0.05 **************************************************
   41.240    -0.22 **************************************************
   44.044    -0.49 **************************************************
   47.039    -0.90 **************************************************
   50.238    -1.49 *************************************************
   53.654    -2.32 *************************************************
   57.302    -3.51 *************************************************
   61.199    -5.16 ************************************************
   65.361    -7.50 ***********************************************
   69.805   -10.86 **********************************************
```

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 6)

```
    74.552   -16.09 *********************************************
    79.621   -25.96 *****************************************
    85.036   -34.34 *************************************
    90.818   -27.15 ****************************************
    96.994   -31.05 ***************************************
   103.589   -40.43 ***********************************
   110.634   -27.99 ****************************************
   119.157   -28.29 ****************************************
   126.191   -48.56 *******************************
   134.772   -28.97 ***************************************
   143.937   -28.08 ****************************************
   153.725   -55.95 ****************************
   164.178   -27.58 ****************************************
   175.342   -32.20 **************************************
   187.266   -30.14 ***************************************
   200.000   -29.33 ***************************************
LOG SCALE?

BEG,END,POINTS?
    30.000     0.13 ***************************************************
    35.000     0.38 ***************************************************
    40.000    -0.13 ***************************************************
    45.000    -0.61 ***************************************************
    50.000    -1.44 **************************************************
    55.000    -2.72 **************************************************
    60.000    -4.61 *************************************************
    65.000    -7.27 ************************************************
    70.000   -11.06 ***********************************************
    75.000   -16.72 *******************************************
    80.000   -27.14 ****************************************
    85.000   -34.48 *************************************
    90.000   -27.30 ****************************************
    95.000   -28.74 ****************************************
   100.000   -38.67 ************************************
LOG SCALE?

BEG,END,POINTS?

WANT TO TRY FOR BETTER RESULTS?

OUTPUT IMPULSE RESPONSE?

....... IMPULSE RESPONSE .......

 H(  1) =  0.23353875E-01 = H( 30)
 H(  2) =  0.10119826E-02 = H( 29)
 H(  3) = -0.39981455E-02 = H( 28)
 H(  4) = -0.11394635E-01 = H( 27)
 H(  5) = -0.19217461E-01 = H( 26)
 H(  6) = -0.24781808E-01 = H( 25)
 H(  7) = -0.25201574E-01 = H( 24)
 H(  8) = -0.18062443E-01 = H( 23)
 H(  9) = -0.21016747E-02 = H( 22)
 H( 10) =  0.22295326E-01 = H( 21)
 H( 11) =  0.52932054E-01 = H( 20)
 H( 12) =  0.86042464E-01 = H( 19)
 H( 13) =  0.11691678     = H( 18)
 H( 14) =  0.14079130     = H( 17)
 H( 15) =  0.15380645     = H( 16)
```

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 7)

```
ENTER COMMAND: (DESIGN, GENERATE OR SAVE)

.......PULSE GENERATION ROUTINE......

SIGNAL HAS FIVE SINE-WAVE COMPONENTS:
ENTER HIGHEST DESIRED FREQUENCY:  (HZ)

COMPONENT FREQUENCIES ARE:
1 AT      4.00 HZ
2 AT     40.00 HZ
3 AT    160.00 HZ
4 AT    400.00 HZ
5 AT    800.00 HZ

ARE THEY ACCEPTABLE?

HOW MANY COMPONENTS ARE DESIRED?
COMPONENT # 1:  WHAT FREQ. (HZ)?
COMPONENT # 2:  WHAT FREQ. (HZ)?
COMPONENT # 3:  WHAT FREQ. (HZ)?
COMPONENT # 4:  WHAT FREQ. (HZ)?
COMPONENT # 5:  WHAT FREQ. (HZ)?

MINIMUM SAMPLING AT     400.0 HZ
ENTER DESIRED RATE (HZ):

LONGEST PERIOD =  1000.000 MSEC.
ENTER DESIRED SIGNAL DURATION (MSEC)

COMPOSIT SIGNAL ( 321 PTS) GENERATED FROM

1 AT      1.00 HZ
2 AT     20.00 HZ
3 AT     35.00 HZ
4 AT     85.00 HZ
5 AT    200.00 HZ

....... FILTERING OF SIGNAL .......

NOTICE:
------
COMPONENTS HAVE FOLLOWING FREQUENCIES:

IN (HERTZ):        1.00       20.00      35.00      85.00     200.00
NORMALIZED:     0.00125     0.02500    0.04375    0.10625    0.25000
WITH SAMPLING AT    300.00 HZ.
IS THE     1.00 HZ COMPONENT INTENDED TO BE FILTERED OUT?
IS THE    20.00 HZ COMPONENT INTENDED TO BE FILTERED OUT?
IS THE    35.00 HZ COMPONENT INTENDED TO BE FILTERED OUT?
IS THE    85.00 HZ COMPONENT INTENDED TO BE FILTERED OUT?
IS THE   200.00 HZ COMPONENT INTENDED TO BE FILTERED OUT?

SIGNAL (NPTS= 321)  HAS BEEN FILTERED.

ENTER  NBEG,NEND,NSKP  FOR OUTPUT,   OR RETURN TO EXIT:

ENTER  NBEG,NEND,NSKP  FOR OUTPUT,   OR RETURN TO EXIT:

ENTER COMMAND: (DESIGN, GENERATE OR SAVE)
```

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 8)

```
FILTER  FILTA   HAS BEEN ENTERED
FILTER NAMED  FILTA   WITH 30 WEIGHTS, 2 BANDS
YOUR SAMPLING FREQUENCY IS  200.0000 HZ.
FROM    0.0 TO    10.0 WITH A GAIN OF 1.0000
FROM   20.0 TO   100.0 WITH A GAIN OF 0.0
IS THIS ACCEPTABLE? ANSWER YES OR NO.
IMPULSE RESPONSE IS  0.233539E-01  0.101198E-02 -0.399815E-02 -0.113946E-01
 -0.192175E-01 -0.247818E-01 -0.252016E-01 -0.180624E-01 -0.210167E-02
  0.222953E-01  0.529321E-01  0.860425E-01  0.116917E+00  0.140791E+00
  0.153806E+00  0.153806E+00  0.140791E+00  0.116917E+00  0.860425E-01
  0.529321E-01  0.222953E-01 -0.210167E-02 -0.180624E-01 -0.252016E-01
 -0.247818E-01 -0.192175E-01 -0.113946E-01 -0.399815E-02  0.101198E-02
  0.233539E-01
QUANTITY NAMED  HEADA   FROM    0.0 TO 200.0 AT    5.0 MSEC INTERVALS
HAS BEEN FILTERED BY  FILTA   AND RENAMED  HFILA
FOR QUANTITY NAMED  HEADA   FROM   0.0 TO 200.0 AT  10.0 MSEC INTERVALS
VALUES ARE            0.99999928        0.33393818        0.66045868
    2.6727352         4.3564796         7.9398336         5.7417002
    12.745187         9.3281813         30.667343         13.937942
    33.141571         30.671356         77.183960         65.537796
    1.4951506         38.680115         7.0939541         23.340271
    5.5462570         7.7674675
FOR QUANTITY NAMED  HFILA   FROM   0.0 TO 200.0 AT  10.0 MSEC INTERVALS
VALUES ARE            0.14098293        0.58383924        1.2402963
    2.2738686         3.6843052         5.4825096         7.5842485
    10.336252         14.206765         19.743851         26.016547
    33.812637         39.400482         41.955795         40.833588
    36.650009         30.811035         24.103973         17.002274
    9.3238602         1.0950766
QUANTITY NAMED  HEADA   MINUS QUANTITY NAMED  HFILA   RENAMED  HFILC
FOR QUANTITY NAMED  HFILC   FROM   0.0 TO 200.0 AT  10.0 MSEC INTERVALS
VALUES ARE            0.85901636       -0.24990106       -0.57983959
   0.39886665         0.67217445         2.4573240        -1.8425484
    2.4089345        -4.8785839          10.923492        -12.678605
  -0.67106629        -8.7291260          35.228165         24.704208
   -35.154846         7.8690796         -17.010010         6.3379974
   -3.7776031         6.6723909
FOR QUANTITY NAMED  TESTV   MEASURES ARE: MIN =     0.0    , MAX =    10.0000
MEAN =     5.0000, VARIANCE =     8.0952, MODE =     5.0000, MEDIAN =     5.0000
FOR QUANTITIES NAMED  HEADA   AND  CHESTA
PHASE CORRELATION COEFFICIENT IS     0.7453
START TIME FOR FIRST QUANTITY IS 130.0 AND FOR SECOND IS 140.0 MSEC.
START TIME SHIFTED FROM    0.0 TO 140.0 MSEC
FOR QUANTITIES NAMED  HEADA   AND  CHESTA
AMPLITUDE CORRELATION COEFFICIENT IS     0.1858 WITH FACTOR OF     1.2000
FOR QUANTITY NAMED  HEADA   FOURIER COEFFICIENTS ARE   18.691
  -16.854    2.558   -1.282   -3.583    3.992  -10.336   -2.907    2.136
   -1.279   -2.908
START TIME IS    0.0 TIME INTERVAL IS    5.0 PERIOD IS 200.0 MSEC.
NUMBER OF HARMONICS IS    5 BASIC FREQUENCY IS     5.0000 CPS.
START TIME SHIFTED FROM    0.0 TO 140.0 MSEC
QUANTITY NAMED   FCHA  , STARTING TIME SHIFTED FROM   0.0 TO 140.0 MSEC
RENAMED  FCHAA
FOR QUANTITY NAMED  HEADA    H.I.C. INDEX =       524.1 WITH T1,T2= 0.1000 0.1750
FOR QUANTITY NAMED  CHESTA  FROM   0.0 TO 200.0 AT    0.0 MSEC INTERVALS
SEVERITY INDEX HAS VALUE  116.0387
FOR QUANTITY NAMED  CHESTA  FROM   0.0 TO 200.0 AT    0.0 MSEC INTERVALS
MODIFIED SEVERITY INDEX HAS VALUE    5.5160
NEW NAMES ARE:  HIPAAX   HIPAIN   HIPAEN   HIPAVR   HIPACF   HIPADD   HIPAEP   HIPANM
FOR QUANTITY NAMED  HIPA   MEASURES ARE: MIN =     0.4001, MAX =    18.3956
```

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 9)

```
MEAN =     8.2111, VARIANCE =    26.7200, MODE =    12.3534, MEDIAN =     8.3276
CONFIDENCE INTERVAL =      6.9498
FOR QUANTITY NAMED  FCHAA    FROM 140.0 TO 200.0 AT    5.0 MSEC INTERVALS,
INTEGRAL IS  207.0776
NEW NAMES ARE: HEADAFR  HEADACM
START TIME SHIFTED FROM    0.0 TO   50.0 MSEC
QUANTITY NAMED  HEADA    FROM  50.0 TO 150.0 AT    5.0 MSEC INTERVALS
HAS FREQUENCY     0.0     WITH COEFFICIENT    25.1162
RENAMED RESPECTIVELY HEADAFR  AND HEADACM
NEW NAMES ARE: HEADAPK  HEADAAV  HEADAIT
FOR QUANTITY NAMED  HEADA    PEAK VALUE IS    77.1840 AT 0.1300 SEC.
THREE MILLISECOND AVERAGE IS    65.6026
QUANTITY NAMED  TESTV    FROM    0.0 TO 200.0 AT   10.0 MSEC INTERVALS
HAS BEEN MULTIPLIED BY    2.000 AND RENAMED  TESTV2
FOR QUANTITIES NAMED  CHESTA  AND   HIPA
CORRELATION COEFFICIENT IS    0.7240 RENAMED   CCC
NEW NAMES ARE:  HIPAVR   HIPANM
NEW NAMES ARE: CHESTAVR CHESTANM
QUANTITY NAMED CHESTAVR NOT FOUND IN CENTROL STORAGE ARRAY.
NEW NAMES ARE:  VELAX     VELIN     VELEN     VELVR
FOR QUANTITIES NAMED  LOWERA ,  UPPERA ,
MEAN CURVE STORED AS    VEL
POINTWISE MEASURES ARE: MAX =  386.2305, MIN = -333.5266, MEAN =    -9.6670
VARIANCE =  19846.5898
START TIME SHIFTED FROM    0.0 TO 100.0 MSEC
QUANTITY NAMED  HEADA  , STARTING TIME SHIFTED FROM    0.0 TO    0.0 MSEC
RENAMED  HEADC
FOR QUANTITY NAMED  HEADC    FROM    0.0 TO 100.0 AT   10.0 MSEC INTERVALS
VALUES ARE              13.937942          33.141571          30.671356
    77.183960           65.537796           1.4951506          38.680115
     7.0939541          23.340271           5.5462570           7.7674675
START TIME SHIFTED FROM    0.0 TO 100.0 MSEC
QUANTITY NAMED  HEADA    SELECTED AT TIME 100.0 MSEC AND RENAMED  HEADD
QUANTITY NAMED  HEADD    HAS VALUE          13.937942
QUANTITY NAMED  HEADA    MINUS QUANTITY NAMED  CHESTA   RENAMED   DIFF
FOR QUANTITY NAMED   DIFF    FROM    0.0 TO 200.0 AT   10.0 MSEC INTERVALS
VALUES ARE              0.55025190         -0.23963165          0.51982870E-01
   -4.1722383          -6.6512556          -3.7969465          -7.1597481
    6.6970081         -11.264211           12.593719          -5.5494171
   21.170212           26.989548           57.091309           46.507507
   -9.5819168          29.162216          -7.9992075           18.160156
   -4.1065454           6.2532504
RESULT OF FORMULA INTERPRETER IS          -24.79     -26.29     -24.76     -25.93
   -21.47    -20.40    -17.35    -31.57    -11.89     -35.51     -16.95     -60.23
   -50.17    -79.50    -69.07    -12.39    -52.65     -14.22     -41.59     -19.05
   -29.01
FOR QUANTITY NAMED    ANSW    FROM    0.0 TO 200.0 AT   10.0 MSEC INTERVALS
VALUES ARE             -24.785385          -26.292684          -24.762009
   -25.932129          -21.465988          -20.403305          -17.348083
   -31.567902          -11.894771          -35.514542          -16.947388
   -60.234497          -50.165344          -79.496979          -69.069809
   -12.394539          -52.649811          -14.220855          -41.591568
   -19.047195          -29.005524
FOR POLAR PLOT, REFERENCE LINES ARE 0.200 BELOW AND 0.200 ABOVE 1.
SCALING PARAMETERS ARE:    -1.4000     1.4000     1.4000    -1.4000     3.2143
    32.1429    67.0000   -19.2857    28.0000     0.0156     0.0259     0.3111
FOR QUANTITIES NAMED   HICA    AND    SIA     POLAR POINT IS OFF PAGE.
POINT WILL BE INVERTED AND PLOTTED.
FOR QUANTITIES NAMED   SIA    AND    HICA    WITH VALUES      116.0387     524.0635
POLAR POINT IS AT X,Y=     0.2181     0.0384 LABELED A
```

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 10)

```
FOR QUANTITIES NAMED   SIA    AND HEADAPK  WITH VALUES      116.0387       77.1840
POLAR POINT IS AT X,Y=    1.0444      1.0815 LABELED B
FOR QUANTITIES NAMED   MSIA   AND   HEADD  WITH VALUES        5.5160       13.9379
POLAR POINT IS AT X,Y=    0.0551      0.3919 LABELED C
FOR QUANTITIES NAMED  HIPAEN  AND  HIPAAX  WITH VALUES        8.2111       18.3956
POLAR POINT IS AT X,Y=   -0.2096      0.3941 LABELED D
FOR QUANTITIES NAMED  FCHAAI  AND   SIA    WITH VALUES      207.0776      116.0387
POLAR POINT IS AT X,Y=   -1.6039      0.7823 LABELED E
FOR QUANTITIES NAMED HEADAPK  AND  HEADD   POLAR POINT IS OFF PAGE.
POINT WILL BE INVERTED AND PLOTTED.
FOR QUANTITIES NAMED  HEADD   AND HEADAPK  WITH VALUES       13.9379       77.1840
POLAR POINT IS AT X,Y=   -0.0251     -0.1788 LABELED F
FOR QUANTITIES NAMED HEADAAV  AND HEADAPK  WITH VALUES       65.6026       77.1840
POLAR POINT IS AT X,Y=    0.3990     -0.7505 LABELED G
FOR QUANTITIES NAMED  VELAX   AND  VELEN   POLAR POINT IS OFF PAGE.
POINT WILL BE INVERTED AND PLOTTED.
FOR QUANTITIES NAMED  VELEN   AND  VELAX   WITH VALUES       -9.6670      386.2305
POLAR POINT IS AT X,Y=    0.0225     -0.0110 LABELED H
FOR PHASE PLANE TYPE PLOT,
SCALING PARAMETERS ARE:    0.0    15000.0000  100.0000    0.0
   0.0087     2.0000    -0.5400    55.0000    57.6923     0.9259
FOR CARTESIAN PLOT,
SCALING PARAMETERS ARE:    0.0       200.0000  600.0000-1000.0000
   0.6500     2.0000    -0.0337    21.2500     0.7692    14.8148
FOR DEVIATION PLOT,
SCALING PARAMETERS ARE:    0.0       200.0000 8000.0000-8000.0000
   0.6500     2.0000    -0.0034    28.0000     0.7692   148.1481
QUANTITY NAMED   CCC    HAS VALUE       0.72398794
```

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 11)

VALIDATION COMMAND LANGUAGE PROGRAM PAGE 1

OUTPUT OF INPUT

COEFFICIENTS A(I) FOR APPROXIMATING POLYNOMIAL F OF DEGREE N

$$F(X) = A(0) + A(1)X + A(2)X^{2} + A(3)X^{3} + \dots + A(I)X^{I} + \dots + A(N)X^{N}$$

I	N = 2	N = 3	N = 4	N = 5	N = 6	N = 7	N = 8	N = 9	N =10	N =
0	0.175324E+01	0.570438E+01	0.569353E+01	0.526287E+01	0.520785E+01	0.522049E+01	0.519149E+01	0.531051E+01	0.525537E+01	
1	0.324675E+02	-0.238116E+03	-0.236813E+03	-0.134194E+03	-0.139385E+03	-0.141078E+03	-0.129272E+03	-0.159546E+03	-0.155051E+03	
2	0.506642E-03	0.346612E+04	0.345600E+04	-0.596911E+03	0.266535E+03	0.270173E+03	-0.480166E+03	0.712497E+03	0.984781E+03	
3	0.0	-0.115539E+05	-0.113201E+05	0.450621E+05	0.192877E+05	0.213362E+05	0.396959E+05	0.259085E+05	0.105037E+05	
4	0.0	0.0	-0.577598E+03	-0.324450E+06	-0.253345E+05	-0.745233E+05	-0.284647E+06	-0.280262E+06	-0.692184E+05	
5	0.0	0.0	0.0	0.652741E+06	-0.849323E+06	-0.384337E+06	0.712915E+06	0.146849E+07	0.855198E+06	
6	0.0	0.0	0.0	0.0	0.273423E+07	0.754996E+06	-0.615500E+06	-0.448744E+07	-0.988187E+07	
7	0.0	0.0	0.0	0.0	0.0	0.315452E+07	-0.505863E+07	0.423176E+07	0.221178E+08	
8	0.0	0.0	0.0	0.0	0.0	0.0	0.229512E+08	-0.285314E+08	0.153509E+09	
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.157207E+09	-0.829451E+09	
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.122505E+10	

I	X	Y	DEGREE 2 FIT	DEGREE 3 FIT	DEGREE 4 FIT	DEGREE 5 FIT	DEGREE 6 FIT
1	0.0	5.00	1.75	5.70	5.69	5.26	5.21
2	0.01	4.00	2.08	3.66	3.66	3.90	3.86
3	0.02	3.00	2.40	2.24	2.24	2.65	2.67
4	0.03	2.00	2.73	1.37	1.38	1.67	1.75
5	0.04	1.00	3.05	0.99	0.99	1.06	1.15
6	0.05	0.0	3.38	1.02	1.02	0.87	0.93
7	0.06	1.00	3.70	1.40	1.40	1.10	1.11
8	0.07	2.00	4.03	2.06	2.06	1.71	1.66
9	0.08	3.00	4.35	2.92	2.92	2.63	2.53
10	0.09	4.00	4.68	3.93	3.92	3.77	3.66
11	0.10	5.00	5.00	5.00	4.99	5.02	4.93
12	0.11	6.00	5.32	6.07	6.07	6.27	6.23
13	0.12	7.00	5.65	7.08	7.07	7.40	7.43
14	0.13	8.00	5.97	7.94	7.94	8.30	8.39
15	0.14	9.00	6.30	8.60	8.60	8.89	9.02
16	0.15	10.00	6.62	8.98	8.98	9.10	9.22
17	0.16	9.00	6.95	9.01	9.02	8.90	8.94
18	0.17	8.00	7.27	8.63	8.64	8.29	8.22
19	0.18	7.00	7.60	7.76	7.77	7.32	7.16
20	0.19	6.00	7.92	6.34	6.34	6.10	5.96
21	0.20	5.00	8.25	4.30	4.29	4.80	4.97

I	X	Y	DEGREE 7 FIT	DEGREE 8 FIT	DEGREE 9 FIT	DEGREE 10 FIT	DEGREE
1	0.0	5.00	5.22	5.19	5.31	5.26	
2	0.01	4.00	3.86	3.89	3.81	3.81	
3	0.02	3.00	2.66	2.69	2.57	2.62	
4	0.03	2.00	1.74	1.74	1.67	1.73	
5	0.04	1.00	1.15	1.13	1.14	1.18	
6	0.05	0.0	0.94	0.92	0.99	0.98	
7	0.06	1.00	1.12	1.11	1.21	1.15	
8	0.07	2.00	1.67	1.67	1.76	1.68	
9	0.08	3.00	2.54	2.55	2.59	2.53	
10	0.09	4.00	3.66	3.67	3.65	3.63	
11	0.10	5.00	4.93	4.93	4.86	4.89	
12	0.11	6.00	6.22	6.22	6.12	6.19	
13	0.12	7.00	7.42	7.41	7.32	7.40	
14	0.13	8.00	8.39	8.38	8.34	8.40	

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 12)

VALIDATION COMMAND LANGUAGE PROGRAM PAGE 2

OUTPUT OF INPUT

I	X	Y	DEGREE 7 FIT	DEGREE 8 FIT	DEGREE 9 FIT	DEGREE 10 FIT	DEGREE
15	0.14	9.00	9.02	9.02	9.06	9.05	
16	0.15	10.00	9.22	9.23	9.33	9.25	
17	0.16	9.00	8.95	8.97	9.08	8.98	
18	0.17	8.00	8.23	8.24	8.28	8.23	
19	0.18	7.00	7.15	7.16	7.07	7.13	
20	0.19	6.00	5.95	5.95	5.78	5.91	
21	0.20	5.00	4.97	5.01	5.09	5.00	

******** CHECK OF FILTERING ROUTINE

N	UNFILTERED SIGNAL	FILTERED SIGNAL	SHOULD BE
1	0.0	0.000000	0.0
6	2.532063	1.747556	1.727151
11	1.843836	1.468374	1.461144
16	-1.562387	-0.026461	-0.006822
21	0.156395	-0.568883	-0.550673
26	0.212089	0.047907	0.043551
31	1.081247	0.166554	0.157327
36	-2.611533	-0.645679	-0.630753
41	0.308961	-0.719394	-0.690988
46	0.877330	0.846140	0.858120
51	3.230515	2.315333	2.306559
56	-0.150139	1.679490	1.681349
61	0.453941	-0.280285	-0.253099
66	-0.605557	-1.081315	-1.049963
71	0.237978	-0.105038	-0.094838
76	-0.365895	0.828894	0.829245
81	0.587735	0.570076	0.587805
86	1.540465	0.310350	0.345412
91	0.884218	1.241606	1.266744
96	1.772695	2.213522	2.217366
101	0.707031	1.406414	1.414245
106	1.303120	-0.561228	-0.528324
111	-2.087190	-1.206718	-1.163482
116	0.254025	0.251122	0.273251
121	0.808841	1.803683	1.808993
126	3.714470	1.715349	1.733675
131	0.005040	0.886801	0.928773
136	0.955520	0.987475	1.024015
141	0.890791	1.584737	1.598122
146	2.588166	1.021257	1.032546
151	-0.341315	-0.496230	-0.458771
156	-1.554561	-0.799607	-0.749723
161	0.950726	0.922322	0.950993
166	3.455292	2.642889	2.650314
171	2.737917	2.335351	2.355084
176	-0.699035	0.810792	0.856468
181	0.967215	0.237311	0.280578
186	1.010030	0.821815	0.841517
191	1.845037	0.907022	0.920816
196	-1.883715	0.060190	0.097053
201	[illegible]	-0.049266	-0.000033
206	1.530383	1.479499	1.511186

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 13)

```
211          3.844975          2.911048          2.920776
216          0.424277          2.235647          2.235801
221          0.937334          0.237372          0.280651
226         -0.113442         -0.603998         -0.557794
231          0.738223          0.331242          0.355008
236          0.040926          1.223489          1.236119
241          0.950783          0.922397          0.951083
246          1.959494          0.619813          0.664503
251          1.158916          1.507735          1.541150
256          2.002189          2.435969          2.446712
261          0.890605          1.584826          1.598190
266          1.441297         -0.427182         -0.390112
271         -1.934592         -1.117280         -1.071262
276          0.300124          0.295838          0.319363
281          0.803513          1.803661          1.808974
286          3.668358          1.670605          1.687551
291         -0.086958          0.797364          0.836551
296          0.717376          0.853605          0.885336
301          0.706417          1.409118          1.414225
306          2.353908          0.772736          0.803236
311         -1.115406         -0.730002         -0.733175
316         -1.873614         -1.034362         -1.068838
321          0.587021          0.082760          0.587675
FREQUENCIES NORMALIZED TO SAMPLING OF        800.00 HZ.
 2 BANDS:   # 1     # 2      #
     FROM: 0.0     0.1000
       TO: 0.0500  0.5000
     GAIN: 1.0000  0.0
 30=LENGTH OF FILTER.    BELOW IS ITS IMPULSE RESPONSE
  0.233539E-01 0.101198E-02-0.399815E-02-0.113946E-01-0.192175E-01-0.247818E-01
 -0.252016E-01-0.180624E-01-0.210167E-02 0.222953E-01 0.529321E-01 0.860425E-01
  0.116917E+00 0.140791E+00 0.153806E+00 0.153806E+00 0.140791E+00 0.116917E+00
  0.860425E-01 0.529321E-01 0.222953E-01-0.210167E-02-0.180624E-01-0.252016E-01
 -0.247818E-01-0.192175E-01-0.113946E-01-0.399815E-02 0.101198E-02 0.233539E-01
0
0
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0
0
0
```

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 14)

```
VALIDATION COMMAND LANGUAGE PROGRAM   PAGE  3

                    POLAR PLOT

EXPLANATION OF CHARACTERS ON PLOT
A =    SIA    DIVIDED BY    HICA    WITH VALUE    0.2214
B =    SIA    DIVIDED BY HEADAPK    WITH VALUE    1.5034
C =   MSIA    DIVIDED BY   HEADD    WITH VALUE    0.3958
D = HIPAEN    DIVIDED BY  HIPAAX    WITH VALUE    0.4464
E = HCHAAI    DIVIDED BY     SIA    WITH VALUE    1.7846
F =  HEADD    DIVIDED BY HEADAPK    WITH VALUE    0.1806
G = HEADAAV   DIVIDED BY HEADAPK    WITH VALUE    0.8500
H =  VELEN    DIVIDED BY   VELAX    WITH VALUE   -0.0250
```

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 15)

VALIDATION COMMAND LANGUAGE PROGRAM PAGE 4

POLAR PLOT

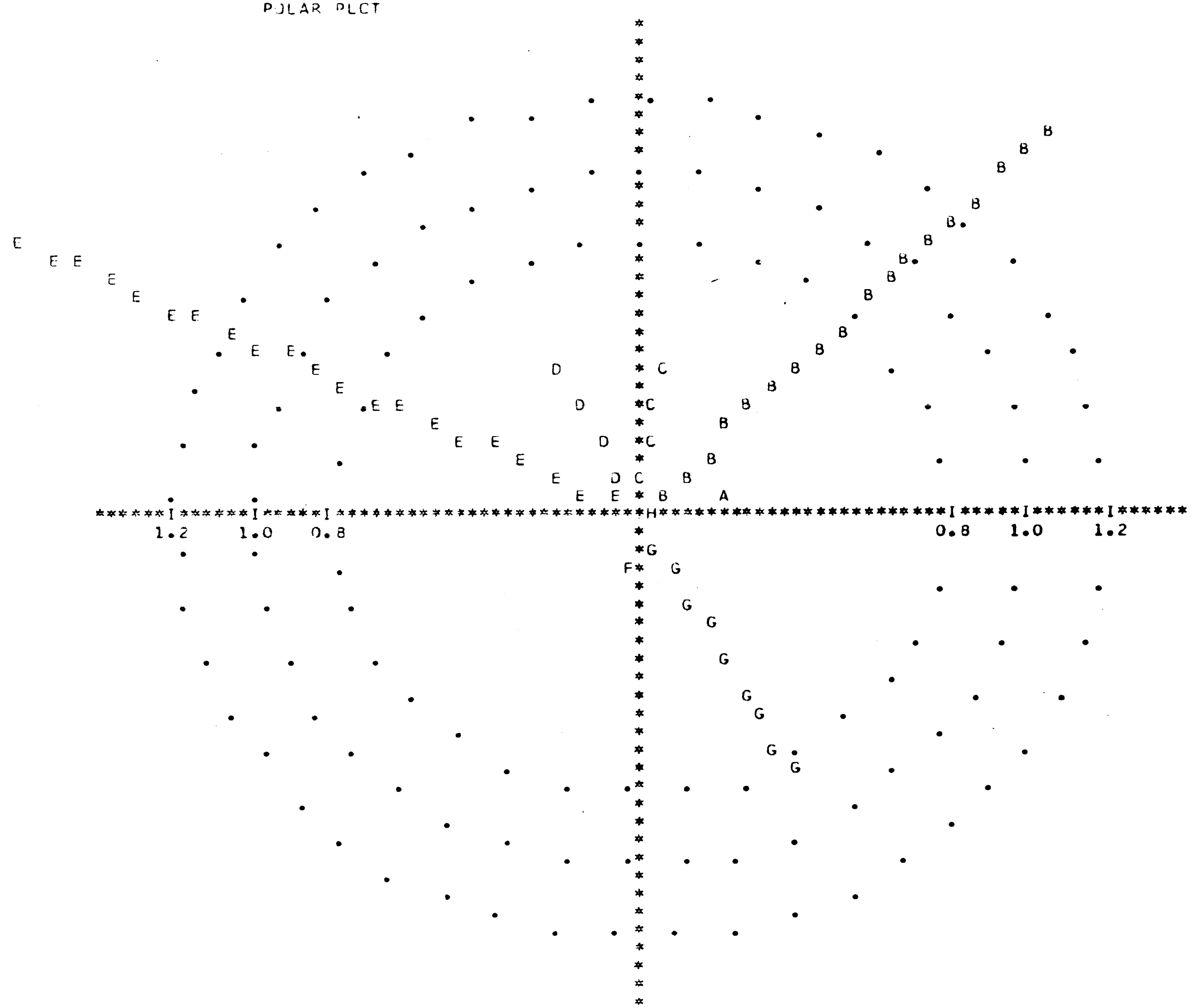

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 16)

VALIDATION COMMAND LANGUAGE PROGRAM PAGE 5

PHASE PLANE TYPE PLOT

FCHA AS Y VERSUS CHESTA AS X.

INDEX	TIME	X	Y	INDEX	TIME	X	Y	INDEX	TIME	X	Y	INDEX	TIME	X	Y
1	0.0	0.0	0.4497	12	55.0	2872.3530	12.3902	23	110.0	3936.8303	11.9713	34	165.0	5183.9453	15.6094
2	5.0	0.0	0.4949	13	60.0	2968.3364	12.9014	24	115.0	3111.8140	9.3344	35	170.0	4959.4922	15.0932
3	10.0	0.0	0.5736	14	65.0	3172.5655	6.5038	25	120.0	2411.4121	3.6818	36	175.0	4241.2461	7.1888
4	15.0	0.0	0.6294	15	70.0	3700.8574	6.0482	26	125.0	2029.1067	14.6871	37	180.0	3829.8455	5.18C1
5	20.0	0.0	0.6085	16	75.0	4523.3906	15.0645	27	130.0	1535.8879	20.0927	38	185.0	3188.6707	11.1284
6	25.0	471.0811	3.3129	17	80.0	5233.2969	20.5924	28	135.0	1805.3345	21.1922	39	190.0	2044.7947	9.6528
7	30.0	1403.6521	6.8450	18	85.0	5594.9258	21.5510	29	140.0	1788.9575	19.0303	40	195.0	695.3335	3.1775
8	35.0	2109.4089	9.6285	19	90.0	5642.0469	18.0736	30	145.0	2526.6716	9.9367	41	200.0	0.0	1.5042
9	40.0	2534.5918	11.0077	20	95.0	5526.7422	17.0044	31	150.0	3506.6338	11.0771				
10	45.0	2736.0012	11.3934	21	100.0	5261.3984	19.4864	32	155.0	4031.5417	5.1856				
11	50.0	2816.0798	11.7368	22	105.0	4678.6484	14.3266	33	160.0	4724.8672	9.5179				
12	55.0	2872.3530	12.3902	23	110.0	3936.8303	11.9713	34	165.0	5183.9453	15.6094				

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 17)

VALIDATION COMMAND LANGUAGE PROGRAM PAGE 6

PHASE PLANE TYPE PLOT

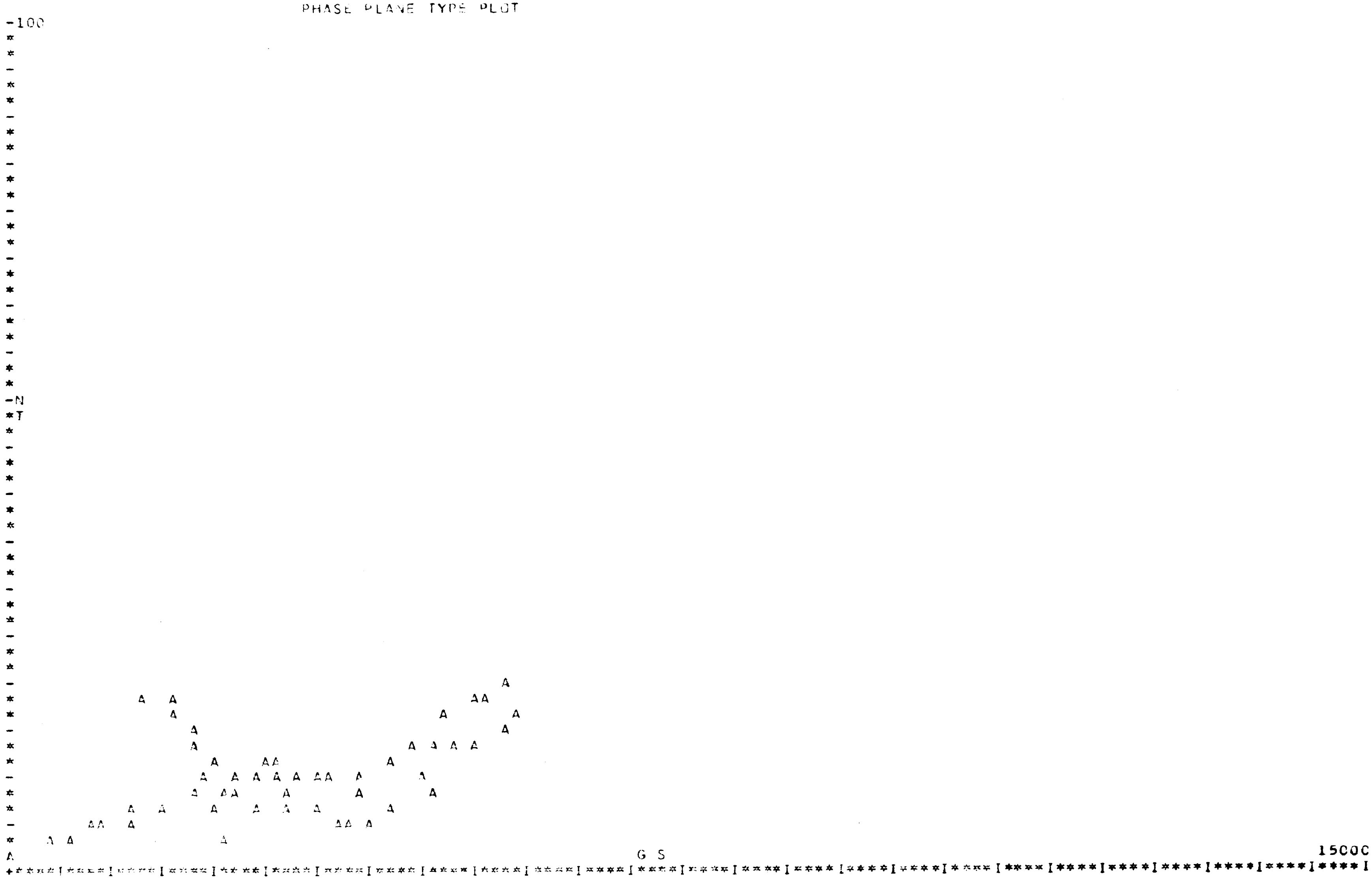

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 18)

VALIDATION COMMAND LANGUAGE PROGRAM PAGE 7

CARTESIAN PLOT

VEL VERSUS TIME LABELED A

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
0.0	0.0	30.0	59.624	60.0	-19.743	90.0	-12.209	120.0	-193.000	150.0	325.714	180.0	-108.191		
5.0	0.0	35.0	97.786	65.0	-65.064	95.0	14.221	125.0	-260.777	155.0	207.353	185.0	-19.378		
10.0	0.0	40.0	128.465	70.0	-15.679	100.0	-4.205	130.0	-235.031	160.0	111.241	190.0	-7.317		
15.0	0.0	45.0	142.762	75.0	16.382	105.0	-61.958	135.0	-65.375	165.0	-110.908	195.0	-26.531		
20.0	0.0	50.0	123.972	80.0	-2.097	110.0	-106.714	140.0	72.291	170.0	-333.527	200.0	-18.680		
25.0	0.0	55.0	63.708	85.0	-23.672	115.0	-179.617	145.0	386.230	175.0	-276.811	205.0UUUUUUUUU			
30.0	0.0	60.0	-19.743	90.0	-12.209	120.0	-193.000	150.0	325.714	180.0	-108.191	210.0UUUUUUUUU			

UPPERA VERSUS TIME LABELED B

TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE	TIME	VALUE
0.0	0.0	30.0	-35.302	60.0	5.288	90.0	-39.436	120.0	316.868	150.0	-100.001	180.0	-528.794		
5.0	0.0	35.0	-87.413	65.0	54.807	95.0	88.469	125.0	249.076	155.0	-143.071	185.0	-746.854		
10.0	0.0	40.0	-127.774	70.0	128.164	100.0	141.036	130.0	323.028	160.0	-22.861	190.0	-911.475		
15.0	0.0	45.0	-131.474	75.0	92.720	105.0	121.079	135.0	438.465	165.0	-253.699	195.0	-814.408		
20.0	0.0	50.0	-93.690	80.0	-26.502	110.0	151.650	140.0	94.212	170.0	-620.856	200.0	-441.819		
25.0	0.0	55.0	-37.199	85.0	-98.514	115.0	121.247	145.0	400.965	175.0	-547.144	205.0UUUUUUUUU			
30.0	0.0	60.0	5.288	90.0	-39.436	120.0	316.868	150.0	-100.001	180.0	-528.794	210.0UUUUUUUUU			

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 19)

VALIDATION COMMAND LANGUAGE PROGRAM PAGE 8

CARTESIAN PLOT

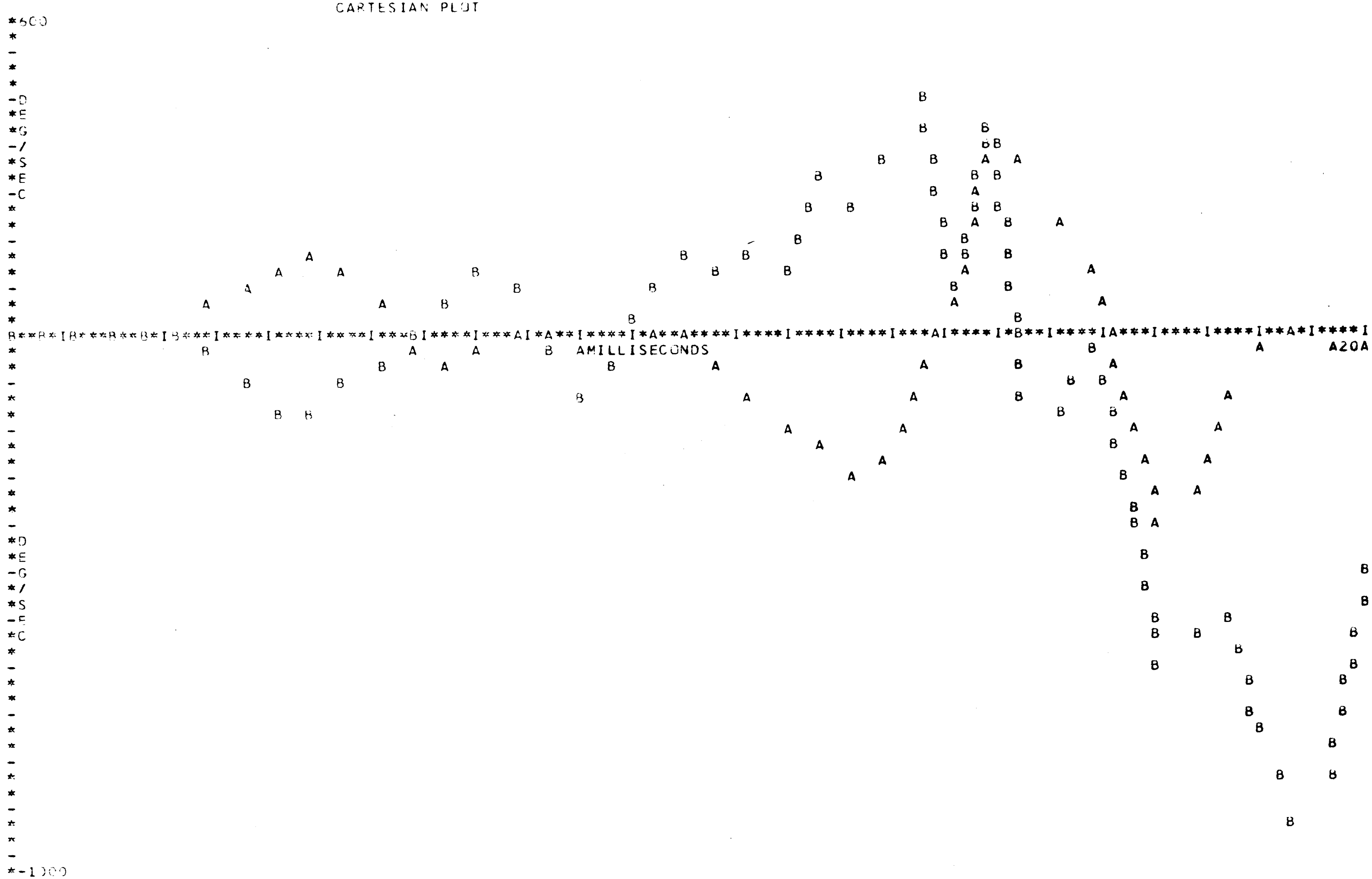

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 20)

DEVIATION PLOT

BELTA MINUS HEADA VERSUS TIME LABELED A

TIME	FIRST	SECOND	DIFFERENCE	TIME	FIRST	SECOND	DIFFERENCE	TIME	FIRST	SECOND	DIFFERENCE	TIME	FIRST	SECOND	DIFFERENCE
0.0	0.0	1.00	-1.00	55.0	2872.35	7.16	2865.20	110.0	3936.83	33.14	3903.69	165.0	5183.95	21.22	5162.72
5.0	0.0	0.77	-0.77	60.0	2968.34	5.74	2962.59	115.0	3111.81	19.79	3092.03	170.0	4959.49	7.09	4952.40
10.0	0.0	0.33	-0.33	65.0	3172.67	10.70	3161.96	120.0	2411.41	30.67	2380.74	175.0	4241.25	44.43	4196.81
15.0	0.0	0.14	-0.14	70.0	3700.86	12.75	3688.11	125.0	2029.11	32.60	1996.51	180.0	3829.85	23.34	3806.51
20.0	0.0	0.66	-0.66	75.0	4523.39	9.92	4513.46	130.0	1535.89	77.18	1458.70	185.0	3188.67	4.40	3184.27
25.0	471.08	1.36	469.72	80.0	5233.30	9.33	5223.97	135.0	1805.33	54.09	1751.25	190.0	2044.79	5.55	2039.25
30.0	1403.65	2.67	1400.98	85.0	5594.93	22.11	5572.82	140.0	1788.96	65.54	1723.42	195.0	695.33	18.91	676.42
35.0	2109.41	1.89	2107.52	90.0	5642.05	30.67	5611.38	145.0	2526.67	15.45	2511.22	200.0	0.0	7.77	-7.77
40.0	2534.59	4.36	2530.24	95.0	5526.74	23.43	5503.31	150.0	3506.63	1.50	3505.14				
45.0	2736.00	6.89	2729.11	100.0	5261.40	13.94	5247.46	155.0	4031.54	47.45	3984.09				
50.0	2816.08	7.94	2808.14	105.0	4678.65	43.81	4634.84	160.0	4724.87	38.68	4686.18				
55.0	2872.35	7.16	2865.20	110.0	3936.83	33.14	3903.69	165.0	5183.95	21.22	5162.72				

CHESTA MINUS HEADA VERSUS TIME LABELED B

TIME	FIRST	SECOND	DIFFERENCE	TIME	FIRST	SECOND	DIFFERENCE	TIME	FIRST	SECOND	DIFFERENCE	TIME	FIRST	SECOND	DIFFERENCE
0.0	0.45	1.00	-0.55	55.0	12.39	7.16	5.23	110.0	11.97	33.14	-21.17	165.0	15.61	21.22	-5.61
5.0	0.49	0.77	-0.27	60.0	12.90	5.74	7.16	115.0	9.33	19.79	-10.45	170.0	15.09	7.09	8.00
10.0	0.57	0.33	0.24	65.0	6.50	10.70	-4.20	120.0	3.68	30.67	-26.99	175.0	7.19	44.43	-37.24
15.0	0.63	0.14	0.49	70.0	6.05	12.75	-6.70	125.0	14.69	32.60	-17.91	180.0	5.18	23.34	-18.16
20.0	0.61	0.66	-0.05	75.0	15.06	9.92	5.14	130.0	20.09	77.18	-57.09	185.0	11.13	4.40	6.73
25.0	3.31	1.36	1.96	80.0	20.59	9.33	11.26	135.0	21.19	54.09	-32.89	190.0	9.65	5.55	4.11
30.0	6.84	2.67	4.17	85.0	21.55	22.11	-0.55	140.0	19.03	65.54	-46.51	195.0	3.18	18.91	-15.73
35.0	9.63	1.89	7.74	90.0	18.07	30.67	-12.59	145.0	9.94	15.45	-5.51	200.0	1.50	7.77	-6.26
40.0	11.01	4.36	6.65	95.0	17.00	23.43	-6.42	150.0	11.08	1.50	9.58				
45.0	11.39	6.89	4.50	100.0	19.49	13.94	5.55	155.0	5.19	47.45	-42.27				
50.0	11.74	7.94	3.80	105.0	14.33	43.81	-29.48	160.0	9.52	38.68	-29.16				
55.0	12.39	7.16	5.23	110.0	11.97	33.14	-21.17	165.0	15.61	21.22	-5.61				

TABLE 16. SAMPLE BATCH INPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 21)

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DEVIATION PLOT

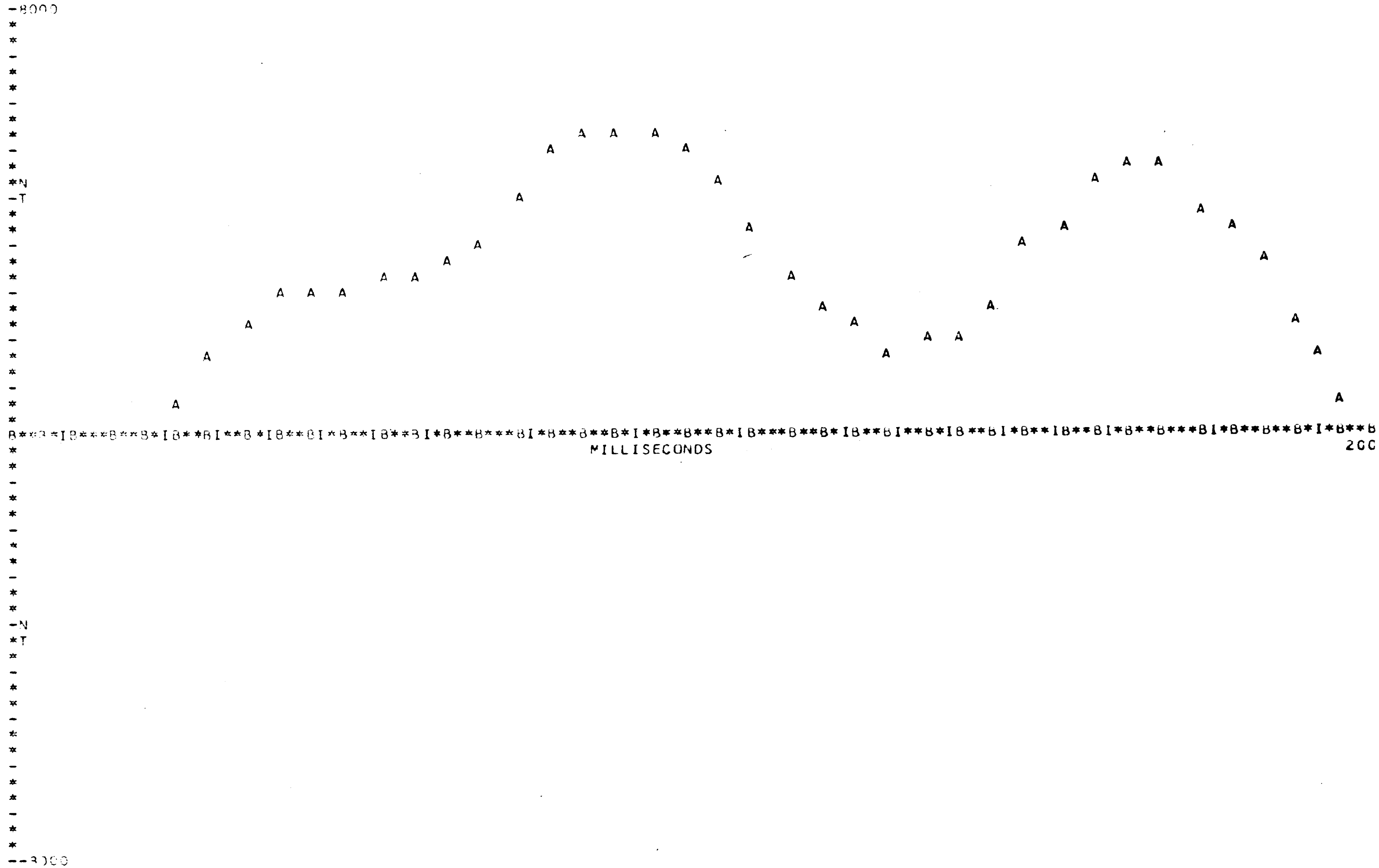

TABLE 16. SAMPLE BATCH OUTPUT, BATCH AUXILIARY OUTPUT AND REGULAR BATCH OUTPUT (Page 22)

3.0 DETAILED PROGRAM INFORMATION

3.1 General Program Description

The following three sections describe the physical makeup of the Validation Command Language.

3.1.1 Organization and Flow

The Validation Command Language is implemented by a total of ninety five subprograms. Table 17 contains a list of all the subprograms together with the routines each subprogram calls and a short description of the function of the subprogram.

3.1.2 Packing Techniques

Two very simple packing systems have been developed for use in the interpreting of the input commands and in the storage of constants and variables (data sets).

Each input command is read character by character, analyzed and packed in free format storage array. The information is then fed to the appropriate subprogram which re-analyzes the packed information and carries out the specified command.

When a data set or a constant is entered into the storage system, a control entry of one of three types is entered into the control array, and the data is entered in a free format storage array. The three types of control entries are for constants, data sets, and for filter weights.

3.1.3 Print Plot Graphics

The plotting section of the Validation Command Language is currently implemented only for producing printer plots. The technique employed is to store a page image originally set to blanks and put in other characters as needed for the particular command. The page image is then printed by the PP command. The plot section also produces printed output which contains the points plotted.

The plotting section would adapt with moderate difficulty to alternative off-line plotter output.

3.2 Program Installation

The principal problem in installing the Validation Command Language is the character handling subprograms involved in the

TABLE 17. SUBPROGRAM TABLE

Routine Name	Routines Called	Description
(main)	INMAIN	set storage size limits
BLOCK DATA	----	defines constants and tables
COMFRQ	INTMAK RINF GETEN SHIFT FOCOLS STOREN	computes and stores frequency with maximum Fourier coefficients
COMPAR	----	select proper type of plot and destination
COMPS	----	calculates factors of N + stop freq. needed for optimization
COMVAR	GETEN, FDIST	compares variances of two quantities by F-distribution and points
CONPAR	INTMAK, RINF	resets default final time, specifies units for output, sets terminal printer switch
CONVER	IDIGIT	reads numbers from input card
CORREL	RINF, GETEN, SHIFT, STOREN	computes, stores and prints correlation coefficient between two quantities
D	----	calculates Lagrange interpolation coefficients for use in GEE
DEL1	----	calculates optimum passband ripple
DEL2	----	calculates optimum stopband ripple
DRAWIT	TITLE	writes plot image and title onto LDNOUT
FDIST	----	computes F-distribution for COMVAR
FETCH	----	gets a particular item of data out of binary storage: for model data
FIGURE	KARDER, CONVER	reads input card for numerical data and converts it
FILDES	OPTIM, SAVAR, REMEZ, REOPT, IMPOUT	designs linear phase finite impulse response filter using REMEZ exchange algorithm
FILGEN	FILDES, GENPUL, SAVCOF	controls design, checking and saving of filter
FILTER	GETEN, FILTNG STOREN	applies a filter to a quantity and stores the result
FILTNG	----	computes filtered signal

TABLE 17. SUBPROGRAM TABLE (continued)

Routine Name	Routines Called	Description
FOCOF	INTMAK, RINF, GETEN, SHIFT, FOCOLS	computes and prints Fourier coefficients, period and basic frequency for a quantity
FOCOLS	----	computes Fourier coefficients by least squares approximation
FORM	----	builds up format for printing out results of regression fitting
FORMIN	IDTFOP, IDTFNM, GETEN, KARDER, SHIFT, OPERTIN, IDTFSM, STOREN	controls formula interpreting
GEE	----	evaluates frequency response using Lagrange interpolation formula in barycentric form
GENPUL	FILTNG	generates a pulse and applies a designed filter to it to check the filter
GETEN	----	gets quantity asked for from internal storage
GMRSII	RINF, GETEN, SHIFT, STOREN	computes and stores GMR modified severity index
GRAFG	----	produces printer plot of frequency response
HIC	----	computes the HIC index
HICC	RINF, INTMAK, GETEN, HIC, STOREN	computes and stores the HIC index
IDENTF	KKIPER	identifies input card
IDIGIT	----	converts numeral into integer
IDTFNM	KARDER, CONVER, PACK	identifies next characters if data set name, constant name, number quantity or binary operator
IDTFOP	----	identifies next characters as unary operator
IDTFSM	----	identifies next characters as binary operator
IMPOUT	----	prints impulse response over terminal

TABLE 17. SUBPROGRAM TABLE (continued)

Routine Name	Routine Called	Description
INMAIN	TITLE, KARDER, IDENTF, FIGURE, CONPAR, MODRUN, SEEKNM, OLDNM, MODAT, TSTRUN, TSTDAT, QUEM, QUEPHA, QUAMP, FOCOF, SHFTZ, FILGEN, FILTER, HICC, SII, GMRSII, NEWNM, INTEG, COMFRQ, THREM, MODAMP, CORREL, COMVAR, PTMNS, REGFIT, FORMIN, PLOTIN, PLOTQT, PLOTCV, PRINTS, DRAWIT, PRINTQ	controls input
INST	----	defines parameters used in FETCH
INTEG	RINF, GETEN, SHIFT, STOREN	computes and stores integral (by Simpson's rule) of quantity
INTMAK	----	makes integer out of data in INFO
INVER	----	decides which data must have its sign changed (y + up on plots)
ISPACE	----	checks plot image to see if blank (not used yet)
IUN	----	defines index for proper model quantity units label given category and column numbers
KARDER	KKTEST	reads input card
KKIPER	KARDER	searches input card
KKTEST	----	checks for previous error return
LABEL	LBLPUT, PUT	gets numerical labels for plots off input card and puts them into the plot image
LBLPUT	PUT	puts numerical labels into plot image
LINE	SCALE, PUT	puts character into the plot image along a specified line
LSQ	FORM, SCAL, TITLE	does least squares regression fitting of one set of data to another
MFIU	----	sets an index for finding proper conversion factor (standard - metric units) given units index for experimental data

TABLE 17. SUBPROGRAM TABLE (continued)

Routine Name	Routines Called	Description
MICON	GETEN, SHIFT, STOREN	computes a new data set which is the difference between two data sets
MODAMP	RINF, GETEN SHIFT,STOREN	multiplies a data set by a constant factor and stores or selects a point from a data set, multiplies it by a constant and stores it
MODAT	RINF, INTMAK, INST, FETCH, INVER, NF, IUN, STOREN	gets data set out of binary storage and stores it
MODRUN	ITHMAK, PICKUP	reads general data out of binary storage
NEWNM	PACK	creates new names as needed for storage
NF	----	defines index for units. conversion factor given category and column numbers
OLDNM	----	reads special names for contacts (catg. 2-4)
OPERTN	SQRT, SIN, COS	computes effects of both unary and binary operators
OPTIM	COMPS, OPTIMN, STOP, DEL1, DEL2	optimizes filter description under control
OPTIMN	----	checks optimization of low pass filters
OUCH	----	prints comments about failure to converge
PACK	----	puts names into INFO
PICKUP	SEARCH	reads special names for categories 2-4 from binary storage
PLOTCV	GETEN, SHIFT, TITLE, LINE, UNITS	gets curve data set(s) from internal storage, puts it (them) into plot image according to type of plot selected and labels axes with proper units and prints summaries
PLOTIN	RINF, SETSCL, SCALE, PUT, LINE, LABEL, TITLE	defines sizes of plots, computes scale factors, puts axes, interval markers and numerical labels into plot image
PLOTQT	RINF, GETEN, SCALE, PUT	gets pair of single points from internal storage and puts their ratio into plot image and prints values
PRINTQ	RINF, GETEN, SHIFT	gets data set from internal storage and prints selected portion over teletype

TABLE 17. SUBPROGRAM TABLE (continued)

Routine Name	Routines Called	Description
PRINTS	GETEN	gets single datum from internal storage as requested and prints it over terminal formula interpreter
PTMNS	RINF, GETEN, SHIFT, STOREN	computes max, min, mean, + variance of mean curve of curves named and stores them and the mean curve
PULOFF	KKIPER, PACK	isolates word on input card and puts it into INFO
PUT	----	inserts character into plot image given mesh coordinates
QUAMP	RINF, INTMAK, GETEN, SHIFT	computes and prints amplitude correlation coefficient of two data sets
QUEM	GETEN, RINF, SHIFT, TP, STOREN	computes and prints or stores max, min, mean, variance, mode, median and sometimes the confidence interval for data set named
QUEPHA	RINF, INTMAK, GETEN, SHIFT	computes and prints phase correlation coefficient of two data sets
REGFIT	RINF, INTMAK, GETEN, SHIFT, LSQ	gets two data sets from internal storage and fits one to the other by least squares
REMEZ	D, OUCH, GEE	"weighted Chebychev approximation of a continuous function with a sum of cosines"
REOPT	GRAFG, SAVAR	"re-estimates parameters"
RINF	----	makes real number out of data in INFO
SAVAR	----	saves filter weights for future use
SAVCOF	STOREN	puts design filter data into internal storage
SCAL	----	scales data for LSQ
SCALE	----	computes mesh coordinates for plot image given values
SEARCH	----	determines last record number of current table
SEEKNM	PULOFF, KKIPER, COMPAR	gets names off input card
SETSCL	----	computes scale factors for POLAR plots
SHFTZ	RINF, GETEN, SHIFT, STOREN	gets a data set from internal storage

TABLE 17. SUBPROGRAM TABLE (continued)

Routine Name	Routines Called	Description
SHIFT	----	selects part of a data set as asked for
SII	RINF, GETEN, SHIFT, STOREN	computes and stores severity index for a data set
STOP	----	calculates optimum lowpass filter stopband frequencies
STOREN	----	puts data or data set into internal storage
TAPRED	----	dummy
THRAVG	----	locates peak value and computes 3 millisecond average of data set
THREM	RINF, GETEN, SHIFT, THRAVG, STOREN	gets data set from internal storage, computes and stores 3 msec av, peak value and time of start of 3 msec interval
TITLE	----	prints titles for plots and their summaries and for regression fitting output
TP	----	computes student's T-distribution for confidence interval
TSTDAT	RINF, INTMAK, TAPRED, MFIU, SHIFT, STOREN	reads experimental data, converts it if necessary, and puts it into internal storage
TSTRUN	INTMAK	defines logical device number for experimental data
UNITS	PUT	puts units label into plot image

recognition of input commands. This impending problem was planned for in the design of the Command Language by setting of a number of key parameters which as much as possible controlled the character handling. These parameters are called Compilation Parameters and are defined at the end of the Block Data Subprogram. The Compilation Parameters are shown in Table 18 together with a description of each one.

3.3 Specialized Subroutines

The Validation Command Language gathers together many special purpose subprograms from many places. The next five sections describe some of the more prominent of these routines.

3.3.1 Input Conversions Subroutines

These routines were developed for the Vehicle Crash Simulation Executive System.* These routines feature a free format presentation of data and a more general way of representing the number. The general form of numeric representation is as follows:

(S)(N ... N)(.) (N ... N) ((D/E) (S) (N(N)))

"S" stands for plus or minus sign; "N" stands for numeric digit; the single '.' for decimal point, "D/E" stands for the letter "D" or the letter "E", and parenthesis means something that is optional. Blanks are ignored. If neither "D" nor "E" is present and there is an exponent, the sign must be present. If no number is presented but a place for a number is presented, (e.g., ",," or ",*"), the value is filled with the default value code word which is a huge positive number. Since the current program does not inspect the converted values for this value in any case except final times, the user must not default individual quantities except final times.

3.3.2 Tape Reading Subroutine

Tape reading is not implemented as part of the current Command Language. If the user wishes to read tapes, he must supply a tape reading routine named "TAPRED" which makes use of the following four arguments

(a) an inputted integer which gives the file or record number if useful;

* Reports in preparation under NHTSA contract.

TABLE 18 COMPILATION PARAMETERS

Parameter	Description	Current Value
IDFULT	Numeric quantity default code word	$(77777777)_{16}$
KCHPWD	Number of characters per integer word	4
KWDPNM	Number of integer words per name	2
KWDPRL	Number of integer words per real word	1
LDIGIT	Maximum number of digits in input numeric quantity	12
LDNFLT	Logical device number for table of predefined filters	8
LDNIND	Logical device number for command input	5
LDNOUT	Logical device number for batch output	6
LDNTTP	Logical device number for interactive, auxiliary and diagnostic output	7
MPOWER	Maximum magnitude of power of ten in a numeric input quantity	20

(b) an inputted integer which gives the logical device number to which the tape is attached

(c) an integer array containing the Volume name in EBCD

(d) an integer array containing the File name in EBCD

A maximum of 401 points can be accomodated and these must be read into the array P in the following COMMON statement:

```
COMMON/PQ/P(401),Q(401)
```

The data is entered into the storage system by the following call:

```
CALL STOREN (IU,2,1, NP+2,  NP, ST, TI)
```

where

IU is the units dimension code index (See Table 2)

NP is the number of points

ST is the starting time in msec

TI is the time increment in msec

3.3.3 Special Indices Subroutines

The four special indices routines where brought over from the MVMA 2-D Crash Victim Simulation report. Table 19 shows the exponent functional relationship in the Modified Severity Index.

3.3.4 Digital Filtering Subroutines

The filter design routines and the filtering routines were brought over from Dr. Nabih M. Alem of the HSRI staff who modified a program developed by McClellan (See "Whole Body Response Research Program," Second Final Report, UM-HSRI-76-3).

3.3.5 Regression Fitting Subroutine

The regression fitting subroutine was brought over from a stand-alone package developed by Ray Gould at the Willow Run Labs of the University of Michigan in 1963 (internal memo entitled, "Least-Squares Polynomial Fitting Program; WR-57).

TABLE 19 THE EXPONENT FUNCTIONAL RELATIONSHIP FOR THE GMR MODIFIED SEVERITY INDEX

Acceleration range (g's)	Exponent Relationship and Coefficients	Exponent Range
$0 \leq a \leq 7$	$exp = c_1$ $c_1 = -.7$	constant -.7
$7 \leq a \leq 73$	$exp = c_2 + c_3/a$ $c_2 = 2.87258$ $c_3 = -25.00804$	-.7 to 2.53
$73 \leq a \leq 200$	$exp = c_4 + c_5{*}a$ $c_4 = 2.66221$ $c_5 = -.00181102$	2.53 to 2.3
$200 \leq a$	$exp = c_6$ $c_6 = 2.3$	constant 2.3